Current Fluid Therapy Topics and Recommendations During Anesthetic Procedures
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- Intravenous fluid administration is recommended during general anesthesia, even during short procedures.
- The traditional IV fluid rate of 10 mls/kg/hr during general anesthesia is under review.
- Knowledge of a variety of IV fluids, and their applications, is essential when choosing anesthetic protocols for different medical procedures.

Anesthetic drug effects on the cardiovascular system
- Almost all anesthetic drugs have the potential to adversely affect the cardiovascular system.
- General anesthetic vapors (isoflurane, sevoflurane) cause a dose-dependent, peripheral vasodilation.
- Alpha-2 agonists initially cause peripheral hypertension with reflex bradycardia leading to a dose-dependent decreased patient cardiac index. As the drug effects wane, centrally mediated bradycardia and hypotension are common side effects.
- Phenothiazine (acepromazine) tranquilizers are central dopamine and peripheral alpha receptor antagonists. This family of drugs produces dose-dependent sedation and peripheral vasodilation (hypotension).
- Dissociative NMDA antagonists (ketamine, tiletamine) increase sympathetic tone soon after administration. When dissociative NMDA antagonists are used as induction agents in patients with sympathetic exhaustion or decreased cardiac reserve (morbidly ill patients), these drugs could further depress myocardial contractility.
- Propofol can depress both myocardial contractility and vascular tone resulting in marked hypotension. Propofol’s negative effects on the cardiovascular system can be especially problematic in ill patients.
- Potent mu agonist opioids can enhance vagally induced bradycardia.

Why is IV fluid therapy important during general anesthesia?
- Cardiac output (CO) equals heart rate (HR) X stroke volume (SV); IV fluids help maintain adequate fluid volume, preload, and sufficient cardiac output.
- Oxygen delivery to the tissues (DO2) equals CO X arterial blood oxygen content (CaO2); without adequate blood volume (relative and/or absolute hypovolemia) cardiac output decreases, which results in decreased peripheral oxygen delivery, thus tissue ischemia.
- General anesthesia, by nature, depresses (shocks) autonomic, cardiovascular responses and homeostasis. Cardiovascular problems related to general anesthesia occur even with ASA status 1 patients. Intra-operative blood loss will contribute to total circulatory volume loss and therefore exaggerate the cardiovascular depressant effects of general anesthesia.
- In response to hypovolemia, the body preferentially centralizes blood circulation toward the vital organs and away from peripheral tissues.
- Subcutaneous fluid administration during general anesthesia does not replace IV administration as a means to maintain blood volume. Subcutaneous fluids are absorbed poorly during general anesthesia due both to a circulatory shift away from peripheral circulation and an inevitable hypothermia.
- Intravenous fluids can help maintain a patent IV catheter during general anesthesia, which allows for emergency drug administration, if needed.

Perioperative fluid therapy should be tailored to patient requirements
- Appropriate fluid type, rate, and volume should be considered important elements of a patient’s overall anesthetic protocol. Each patient is unique and every anesthetic protocol should be tailored to individual patient anesthetic requirements.
- Patient history, thorough physical exam, and subjective and objective data (laboratory, radiographic) are necessary to plan appropriately an anesthetic protocol.
- Ideally, patient stabilization, including fluid losses, electrolyte imbalances, trauma, and respiratory and cardiovascular diseases should occur prior to anesthesia; however, in emergency situations, anesthetic patient stabilization may not be possible.
Anesthesia fluid therapy; crystalloids (Dibartola)

- Isotonic, polyionic replacement fluids, such as LRS, are popular IV fluids used during general anesthesia.
- Replacement fluids resemble extra-cellular fluid composition and are designed to resupply body fluids and electrolytes within the cardiovascular and interstitial spaces. Within 30 minutes after replacement fluid administration, nearly 80% is lost from the vascular space into the interstitium.
- Replacement fluids can be used to help alleviate acute hypovolemia.
- Maintenance fluids are designed to fill rapidly the interstitial space. Maintenance fluids should NOT be used for volume resuscitation.
- There are many different formulations of crystalloid fluids available. Indications of each kind depend on individual patient needs such as hypovolemia, dehydration, illness, electrolyte, and acid-base imbalances.
- In the last six years the volume of perioperative crystalloid administration has come under scrutiny. An article written in 2008 by Chappell, et al., questioned the existence of a third space and the research that first established fluid rates during general anesthesia. Traditionally, perioperative fluid administration for veterinary patients has largely mimicked, without solid scientific basis, human recommendations. A publication in 2010 by Boscon, et al., in demonstrated that not only did urine production in healthy, anesthetized dogs consistently decrease, it was coupled with an increase in body water weight. In 2013 an article in JAHAA provided new recommendations for fluid therapy with veterinary anesthesia patients. Based on these recommendations, canine fluid rates should start at 5 ml/kg/hr, feline rates at 3 ml/kg/hr, and fluid formulation, volumes, and rates should be adjusted according to individual patient needs.

Anesthesia fluid therapy; colloids

- Replacement crystalloids are beneficial to help expand rapidly the vascular space when increased blood volume is needed. Unfortunately large volumes of crystalloid potentially can lead to issues such as dilutional hypoalbuminemia, dilutional coagulopathies, decreased pulmonary function, decreased tissue oxygenation, and increased water weight. Approximately 80% of the volume of intravenous crystalloids equilibrate with the interstitial space within 30 to 45 minutes after administration. Unless the underlying cause of hypovolemia is corrected, more crystalloid therapy will be required to help maintain cardiac output, which, in turn, worsens tissue edema.
- Colloids are fluids that contain large, complex molecules. Like crystalloids, colloids can be used for intravenous fluid expansion; however, unlike crystalloids, colloids remain intravascular as long as the endothelial barrier remains intact.
- There are two major categories of colloids, natural and synthetic. Natural colloids are blood components including packed RBCs, plasma, platelet-rich plasma, etc. Generally, the primary synthetic colloids used in modern medicine are hydroxyl ethyl starches (HES). The two most common HES products used in veterinary medicine are Hetastarch® and Vetstarch®. Vetstarch® is the only HES colloid approved for veterinary use.
- There are two principles the general practitioner should understand regarding HES colloids: molecular weight (MW) and C2/C6 substitution ratios. HES colloids are divided into 3 groups according to their average molecular weights: high MW (>400 kDa); medium MW (200-400 kDa); and low MW (<200 kDa) solutions. The molecular weight determines duration of action, the larger the MW the longer the duration of action. The C2/C6 ratio is the ratio of carbon position 2 substitutions to carbon position 6 substitutions. The C2/C6 ratio determines the adverse side effects. The larger the C2/C6 ratio the greater the coagulopathic potential. An ideal HES product would be one with a large MW (long DOA) and small C2/C6 ratio (fewer side effects). Unfortunately, the MW of the product mirrors the C2/C6 ratio. Larger MW products have larger C2/C6 ratio and vice versa for smaller MW products.
  - Hetastarch®: 450/0.7 (MW = 450 kDa, C2/C6 ratio = 0.7)
  - Vetstarch®: 130/0.4 (Mw = 130 kDa, C2/C6 ratio = 0.4)
- Indications for colloid administration include hypovolemia, hypoalbuminemia, and hypotension. Because HES colloids are large molecules, similar to albumin, they tend to remain in the vascular space adding to the colloidal oncotic pressure. Administration of HES will contribute its own volume, plus a third of its volume in water drawn from the interstitial space, to the total blood volume. Some practitioners prefer to use HES plus a crystalloid combination (50:50), which can be very effective for rapid IV volume loading. Another option, which provides even more rapid vascular expansion, is HES plus hypertonic saline.
- HES can be used as the primary fluid therapy in hypoalbuminemic patients during general anesthesia with or without crystalloids. HES can also be given as intermittent IV boluses to help mitigate hypotension.
- Coagulopathies are the primary, adverse effects of HES products dictated by the C2/C6 molecular substitution ratio. All HES products have the potential to inhibit the Von Willebrand factor (vWF) and factor VIII resulting in platelet dysfunction, or type 1 Von Willebrand-like syndrome. Because of these concerns, an anecdotal, maximum dose HES colloids of 20 ml/kg/day was established for human patients. Veterinary medicine simply borrowed this dose and...
applied it to animal patients. Based on the principle of the C2/C6 molecular substitution ratio, an across-the-board, “maximum” dose for all HES products in all patients does not make medical sense. In addition, multiple studies have demonstrated the coagulopathic effects of HES products are clinically irrelevant unless the patient has a preexisting coagulopathy (vWD in Doberman Pinschers).

- Recently, there have been concerns with the administration of HES in human, septic patients, which resulted in acute renal failure. Although there has not been a cause and effect established, the FDA has issued a warning regarding HES use in humans with septicemia. Acute renal failure associated with HES use in septic veterinary patients has NOT been documented. The FDA warning does NOT apply to veterinary medical practice.
- Acute fluid overload, especially in cardiac patients, can occur when colloids are administered rapidly in large volumes. Care should be taken when using colloids (any IV fluids) in patients with known cardiac disease.

**Mitigating hypotension during anesthesia in the small animal patient**

- Most organ systems in the body autoregulate their own blood perfusion within a systemic mean arterial pressure (MAP) range of 60 – 150 mmHg. Outside this range blood perfusion autoregulation becomes a product of systemic blood pressure. When MAPs fall below 60 mmHg, the risk of tissue ischemia increases.
- The number one cause of hypotension in anesthetized veterinary patients is excessive anesthetic depth. Having one person dedicated to monitoring the anesthetized patient and who understands how to assess depth of anesthesia is essential for safe anesthetic practice.
- Bradycardia can contribute to hypotension because CO is a function of HR X SV. Several factors contribute to bradycardia during general anesthesia, including hypothermia and the pharmacodynamics of anesthetic drugs. Patients should be kept warm (> 97 °F) during general anesthesia, and an anticholinergic can be administered to help treat bradycardia resulting from high vagal tone.
- Absolute hypovolemia results in systemic hypotension. Ongoing surgical blood loss should be treated with IV fluid administration, including crystalloids and colloids. Extensive hemorrhage (> 20% patient blood volume) can be managed with IV hypertonic saline, HES, and crystalloids until replacement blood therapy can be conducted.
- One cause of relative hypovolemia is systemic vasodilation and/or depressed myocardial contraction. It is advisable to secure adequate blood volume (rule out absolute hypovolemia) before treating hypotension pharmacologically. Systemic vasodilatation can be treated with a vascular pressor agent (ephedrine, dopamine, vasopressin), whereas depressed myocardial contractility can be treated with a positive inotrope (dobutamine).

**References**


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Post-Anesthesia Complications with the Small Animal Patient
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• The recovery period is not always regarded as a vital component of an anesthetic procedure.
• In veterinary anesthesia the majority of adverse events occur during recovery.

Anesthetic recovery
• Anesthetic recovery is the interval from the cessation of anesthetic drug delivery to the point at which the patient is extubated and has voluntary motor control.
• Factors that affect the length of recovery include patient health, length of the anesthetic procedure, anesthetic protocol, and patient, post-anesthetic body temperature.
• According to a Brodbelt, et al., study in 2007, greater than 50% of the canine and feline anesthetic related adversities occur during recovery.
• Thorough planning of the anesthetic event, anticipating problems, and keeping good anesthetic records during the pre-, intra-, and post-operative periods is essential.
• All anesthetic patients have the potential for poor recoveries. Difficult anesthetic recoveries can be due to multiple factors, including emergence delirium, dysphoria, inadequate analgesia, and general patient discomfort. In these cases, it is often advisable to delay the recovery to avoid further stress or injury to the recovering patient.

Anesthetic recovery: patient monitoring
• In the 2008, Brodbelt, et al., article, the authors speculated that inadequate patient monitoring may have been the primary factor behind anesthetic recovery periods being over represented by increased mortality rates in small animal anesthetic procedures.
• Anesthetic monitoring should NOT end at recovery; instead, it should continue until the patient is extubated and has returned voluntary muscle control.
• The degree of monitoring, and parameters evaluated, depend on the procedure performed and the patient’s health. Patient monitoring should include at least cardiovascular and respiratory status, body temperature, analgesia, and patient (dis)comfort. Post anesthetic, patient monitoring parameters should be included within the patient’s anesthetic records.

Anesthetic recovery: extubation
• Indications for patient intubation include decreasing the risk of aspiration, securing the patient’s airway, and providing a means for assisted ventilation. Patient intubation should be included with any procedure that involves a level of sedation or anesthesia in which the patient has lost motor control and therefore the ability to guard the larynx.
• Extubation should be performed when the recovering patient has regained laryngeal or pharyngeal sensation and reflexes, such as gagging, swallowing and chewing.
• Brachycephalic breeds have an increased risk of post-extubation, upper airway obstruction. During sedation and anesthesia excessive peri-laryngeal tissues and hypoplastic tracheas predispose these patients to pharyngeal obstruction. Ventilatory function should be monitored closely with brachycephalic breeds during pre-operative sedation and post-operative recovery, and it is prudent to have induction agent, a laryngoscope, and an endotracheal tube immediately available in case of upper airway obstruction.

Anesthetic recovery: other breed/species issues
• Alaskan malamutes, Siberian huskies and Labrador retrievers have a genetic polymorphism that predisposes these breeds to a high incidence of opioid-related dysphoria. Problems related to opioid use in those breeds tend to be individualistic; however, it is advisable to use lower doses, especially in Nordic breed dogs. Opioid dysphoria in any breed (or species) can be reversed using naloxone.
• Post-anesthesia related feline blindness (deafness) was reported as early as 2001. Unlike the dog, which has two arterial blood supplies to the brain (internal carotid and basilar arteries), cats have only one cerebral blood supply (maxilllary artery). Spring-loaded mouth gags, used during procedures requiring mandibular extension (dentals), in cats can result in obstruction of the maxillary arterial blood flow causing cerebral ischemia, central blindness, and/or deafness.
Anesthetic recovery: supplemental oxygen
Post-operative oxygen supplementation is most beneficial in patients with compromised respiratory function, sick patients, obese and pregnant patients, and brachycephalic breeds.

Anesthetic recovery: patient welfare
- Post-anesthetic monitoring goes beyond recording a patient’s physiological and analgesic parameters. Post-anesthetic monitoring, more importantly, includes observing the patient’s general welfare.
- Post-anesthetic patient welfare considerations encompass the entire patient-condition during recovery, including physiological, analgesic, patient comfort, body temperature, and human interaction.
- Human touch and voice have a calming effect on animal patients recovering from general anesthesia. It is important that an individual remain with the recovering animal patient in order to maintain post-anesthetic monitoring and provide patient comfort.

Anesthetic recovery: body temperature
- Post-anesthetic patient hypothermia is the number one complication related to general anesthesia in human and veterinary medicine. The combination of dose dependent depression of the thermoregulatory centers, due to anesthetic drugs, and a cold surgical environment can result in significant loss of body heat.
- In human medicine, the discomfort of post-anesthetic hypothermia and uncontrollable shivering is well documented.
- Hypothermia can predispose to bradycardia, delayed recovery, and post-operative shivering.
- It is imperative to mitigate patient hypothermia throughout the entire anesthetic event, including recovery, by employing external heat sources such as warm water circulating blankets and forced warm air blowers.
- Intra- and post-operative patient hyperthermia is uncommon in veterinary medicine. Primary causes of anesthesia-related hyperthermia in animal patients include preoperative fever and iatrogenic sources such as excessive external heating.
- Malignant hyperthermia-like syndrome (MH) has not been proven to be a genetic condition in dogs or cats; however, there have been documented cases involving grey hounds and a Siberian husky that demonstrated a clinical condition similar to MH in humans.

Anesthetic recovery: reversal agents
There are times when it is beneficial to reverse anesthetic drugs and hasten recovery; however, judgment is necessary weighing the advantages of drug reversal versus allowing slower recoveries. When reversing the sedative effects of some anesthetic drugs, opioids and alpha 2 agonists for example, analgesic properties will be reversed also.

References
Neonatal, Pediatric, and Geriatric Anesthesia
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- Neonates are not considered routine candidates for veterinary anesthesia. Due to their size and anatomical and physiological differences, puppies and kittens be challenging to anesthetize safely.
- Early spays and neuters before adoption is a common practice, and knowledge regarding pediatric physiology and pharmacokinetics of anesthetic drugs is essential for successful anesthesia.
- Like us, our pets are living longer. Although most of the customary principles of veterinary general anesthesia are applicable to geriatric patients; there are important differences that should be considered.

Definitions: neonatal, pediatric puppies and kittens
- In humans, the neonatal period is from birth to 4 weeks and the pediatric period is 4 weeks to approximately 2 years old. Adults are considered twenty years and older.
- In small animal veterinary medicine, puppies and kittens are considered neonates from birth to 2 to 4 weeks old, and pediatric patients are 4 to 8 weeks old. Beyond 8 to 12 weeks, puppies and kittens are considered young adults.

Physiological differences of neonatal and pediatric small animal patients.
- Respiratory system: Neonatal puppies and kittens have a greater prevalence of upper airway obstruction due to their large tongues and small airway openings. As they age and tissues grow, these unique anatomical challenges improve in most species except in brachycephalic breeds.
- Rapidly growing puppies and kittens have a high oxygen demand; therefore, they require a high minute ventilation compared with adults. Their tidal volume and functional residual capacity are fixed; therefore they depend on respiratory frequency to meet metabolic oxygen demands. Respiratory control and autonomic responses are immature and easily depressed by anesthetic drugs. Puppies and kittens under the age of 8 weeks old are highly susceptible during anesthetic procedures to apnea and hypoxia.
- Cardiovascular system: Neonates and puppies/kittens (<8 – 12 weeks old) depend on HR to alter cardiac output. They have limited ability to adjust their myocardial contractility, thus stroke volumes are fixed. Unfortunately, they are also prone to bradycardia due to immature sympathetic responses and susceptibility to hypoxemia. Because of their immature vascular and autonomic systems, they cannot rely on vascular tone to help regulate mean arterial pressures (MAP) or tissue perfusion. Neonatal and pediatric blood pressure is almost entirely a function of cardiac output.
- Bottom line: Neonatal and pediatric puppies and kittens require oxygen supplementation and ventilation support, whereas bradycardia should be avoided during general anesthesia.
- Hematopoesis does not begin effectively until approximately 12 weeks of age and fetal hemoglobin is rapidly being removed, making these young patients highly susceptible to anemia. Adult small animal patients can tolerate up to a 20% surgical blood loss, while neonatal and pediatric patients are limited to a loss of 4%.
- Renal and hepatic systems: Although neonatal, pediatric puppy/kitten kidneys and livers are anatomically developed, they are immature functionally until 8 to 12 weeks of age. Their ability to biodegrade anesthetic drugs is slow, resulting in rapid pharmacodynamic effects and slow recoveries. Their renal function, fluid balance, and ability to concentrate urine are undeveloped, making these young animals susceptible to dehydration and intolerant of excessive fluid administration. Glycogen production and storage are inadequate making them susceptible to hypoglycemia.
- Thermoregulation: Neonatal and pediatric small animal veterinary patients have a high surface area with underdeveloped ability to thermoregulate. Severe hypothermia is of great concern during general anesthesia in small patients and may cause brady-arrhythmias, delayed recoveries and possibly death.

Anesthetic considerations for neonatal and pediatric small animal patients.
- Do not fast neonatal and pediatric patients before anesthesia; otherwise, there is a risk of hypoglycemia. The current recommendations are to allow the baby to nurse or feed until anesthesia for patients < 6 weeks old, withhold food no more than 2-3 hours for 6 to 8 week olds, monitor blood glucose at least every 30 to 60 minutes, and administer IV 2.5% dextrose if blood glucose drops below 80-100 mg/dl.
- Anesthetic drugs will produce profound effects and last longer in neonatal and pediatric veterinary patients. Use injectable and premedications judicially. More often it is better to mask induce neonatal patients, intubate, and place an IV catheter without using premedications.
When using injectable drugs, it is recommended to avoid those known to have slow half-lives and require extensive biodegradation (acepromazine for example). Water soluble, short acting drugs, with known antagonists (midazolam, methadone, butorphanol, for example), at lower doses are better choices. Due to the risk of marked bradycardia and decrease cardiac output, alpha two agonists are not recommended in puppies and kittens under 8 weeks old.

- Avoid blood loss and use caution when administering IV fluids so as to not overload delicate cardiovascular systems.
- Monitor heart rate, ventilation, and oxygenation, body temperature, and blood glucose closely during general anesthesia. Employ external warming devices and bubble wrap extremities to help maintain body temperatures near normal.
- Post-operative care should include supplemental oxygen and heat, monitor blood glucose, and supplemental dextrose, as needed, and provide appropriate analgesics.

Definitions: geriatric dogs and cats
- Dorland’s Medical Dictionary (27th ed.) defines geriatric as “old age” or elderly. Most people consider human geriatrics as 65 years old because Medicare eligibility begins. Technically, there is no specific age that defines “geriatric” in humans.
- Dogs that have lived 75 – 80% of their lifespan are considered geriatric, which for small breeds is greater than 10 years old, large breeds 6 – 10 years old.
- Cats are considered geriatric when they are 12 years old and older.

Important considerations for veterinary geriatric anesthesia patients
- Increased age is NOT equivalent to increased risk of general anesthesia unless there are concurrent disease processes. Brodbelt, et al., estimated the risk of anesthetic depth increased up to 7 times for veterinary geriatric patients greater than 12 years old.
- Biological and physiological age is more important than chronological age when considering anesthesia in older patients.
- Geriatric veterinary patients have blunted homeostatic responses, including autonomic and somatic reflexes.
- Underlying disease processes and urgent care should be treated before commencing to general anesthesia.

Physiological/pharmacological considerations for veterinary geriatric anesthesia patients
- Due to decreased metabolic demand, minute ventilation and cardiac output are reduced. The geriatric pulmonary system is less compliant, resulting in an increased work of breathing. Assisted ventilation during general anesthesia is recommended.
- Increased age results in a greater influence of vagal tone and reduced cardiac sympathetic responses. Myocardial and/or degenerative cardiac changes are seen more frequently in elderly veterinary patients, including valvular endocardiosis in small breed dogs and HCM in hyperthyroid cats.
- Although renal and hepatic organ systems continue to work sufficiently in older patients, with age there is a gradual loss of functional capacity. It is advisable to include a CBC and plasma chemistries as part of the pre-anesthetic work-up with geriatric patients. Decreased cardiac output results in decreased hepatic blood flow, which can lead to prolonged drug metabolism and slower patient recoveries.
- Geriatric veterinary patients generally handle most anesthetic drugs and protocols without concern. Clinical differences include increased sensitivities to anesthetic drugs, decreased MAC of inhalant anesthetics, and prolonged recoveries. The exact cause of increased sensitivities to anesthetic drugs seen with geriatric patients is unknown.
- Anesthetic drug recommendations for veterinary geriatric anesthesia patients include lower drug doses and use of short acting, water soluble anesthetic drugs that have known antagonists. Examples of anesthetic drugs used commonly with geriatric veterinary patients include benzodiazepines, opioids, propofol, alfaxalone, isoflurane, sevoflurane, and others.
- Low doses of alpha two agonists are safe to use in geriatric dogs with normal cardiac function. Dexmedetomidine is the drug of choice for elderly cats with HCM; however, ketamine should be avoided.
- Geriatric patients have a higher risk of cognitive dysfunction, which may make them more susceptible to emergence delirium and confusion during anesthesia recovery.
- Judicial dosing of Tramadol is necessary for geriatric patients receiving serotonin/norepinephrine uptake, or MAO inhibitors (selegiline), to avoid serotonin syndrome.

References
Intermittent positive pressure ventilation using mechanical ventilators has not been used traditionally in veterinary practice. Modern mechanical ventilators have become more affordable and easier to operate, allowing an increase use in clinical practice. Understanding the mechanics, function, and physiological effects of mechanical, intermittent, positive pressure ventilation is necessary in order to safely, and effectively, ventilate anesthetized veterinary patients.

**Terminology and physiology**

- Minute ventilation (VE) = Respiratory rate (f) X Tidal volume (TV).
- Under normal physiological conditions PCO2 dictates minute ventilation (VE). Oxygen has little effect on VE unless the PO2 falls below 60 - 70 mmHg.
- CO2 crosses the blood brain barrier where it combines with water in the CSF. Carbonic anhydrase in the CSF facilitates the formation of carbonic acid which then dissociates into hydrogen and bicarbonate ions. The hydrogen ions then interact with the chemoreceptors of the dorsal respiratory group:
  \[ CO_2 + H_2O \leftrightarrow H_2CO_3 \leftrightarrow H^+ + HCO_3^- \]
- Hypoventilation is synonymous with increased PCO2 whereas hyperventilation is synonymous with decreased PCO2.
- With increased PCO2, respiratory drive will increase, with decreased PCO2, respiratory drive will decrease.
- IPPV = intermittent positive pressure ventilation, PIP = peak inspiratory pressure, PEEP = positive end expiratory pressure
- There are many ways one can control ventilation with anesthetized patients: the reservoir bag, a demand valve, or a mechanical ventilator to name a few.

**Indications for controlled ventilation**

- Hypoventilation: Hypercapnea, drug induced respiratory depression, trauma, disease, and others.
- Poor oxygenation: Five causes of hypoxemia include: low fraction/pressure of inspired oxygen; inadequate VT; O2 diffusion impairment; ventilation to perfusion mismatch (V/Q mismatch), and pulmonic/anatomic cardiac shunt.
- Depth of inhalant anesthesia: Anesthetized patients, while breathing anesthetic vapors spontaneously, cycle naturally between levels of light and deep planes of general anesthesia. Controlled ventilation provides a constant rate of inhaled anesthetics, thus eliminating the variability of inhalant general anesthesia.
- Surgeries that involve the loss of negative pressure and mechanical tethering between the visceral and parietal pleurae require intermittent positive pressure ventilation.
- Specific pulmonary diseases require assisted ventilation during general anesthesia, examples include: chest trauma, diaphragmatic hernia repair, severe alveolar diseases, and pleural diseases.
- Patients with conditions that may significantly limit VT, such as pregnancy or obesity, should receive ventilatory support during general anesthesia.
- In reality, indications for controlled ventilation are not always well defined. Ventilators are useful tools during general anesthesia, however; they should be used according to each patient’s individual and should never replace human intervention. Always monitor patients under general anesthesia receiving mechanical ventilation closely. Mechanical ventilators can induce serious patient pulmonary damage, even death, if not set-up and monitored correctly.

**Controlled ventilation**

- Mechanical ventilation is based on VE, which is function of f X VT
- Adjustment of VE requires changes in ventilation frequency and or volume.
- Volume mode: Volume mode ventilator will deliver a controlled volume of gas (patient’s VT), regardless of the peak inspiratory pressure. The variable factor is pressure. Small animal patient VT is approximately 10-20 ml/kg. Most anesthetic mechanical ventilators are set volume mode or have a volume mode option. During long periods of mechanical ventilation volume mode ventilators can cause pathological changes to the pulmonary tissues.
- Pressure mode: Pressure mode ventilator will deliver a volume gas until a set pressure is reached. The variable factor is volume. Most mechanical ventilators that have pressure mode also have volume mode option. Pressure mode ventilation causes fewer pathologic changes to pulmonary tissues than volume mode ventilation.
• Time-cycled ventilation: Despite volume vs. pressure mode ventilation, almost all mechanical ventilators are time-cycle controlled based on respiratory frequency (breaths per minute). Typically, timing is controlled electronically.

Basic anatomy of an anesthesia mechanical ventilator
• Most anesthetic mechanical ventilators have two gas sources. The driving gas is any type of high pressure gas that drives the bellows, from outside, thus pushing (positive pressure) the tidal volume into the patient (compressed O2, medical gas, N₂, CO₂). Maximum pressure of the driving gas should not exceed 50 psi. The breathing system gas is on the inside of the bellows and is continuous with the patient’s breathing circuit. Remember, the driving gas and breathing gas are two, separate gases and should not mix.
• Bellows. Most anesthetic mechanical ventilators use a bellows to push the breathing gas Vₜ into the patient. Bellows are classified as ascending or descending, based on the direction the bellows move during exhalation.
• Control panel. Anesthetic mechanical ventilators have a control panel that allows adjustment of patient Vₜ, breathing frequency, and sometimes I:E ratios.
• Scavenging system. Because the inside of the ventilator bellows is continuous with the patient’s breathing gases, the ventilator attaches to the anesthetic machine scavenging system for evacuation of waste gases.
• Connecting hose and wall plug-in. Anesthetic mechanical ventilators have a hose that connects to the high pressure gas driving the bellows. The hose should be color-coded according to the driving gas; for example, oxygen is green, and medical air is yellow.

Capnography
• Under normal physiological conditions the primary indication for mechanical ventilation during general anesthesia is patient CO₂. There are two ways to monitor patient PCO₂: arterial blood gas analysis and/or end-tidal PCO₂ (PₑₜCO₂, capnography). Although arterial blood gas analysis is more accurate, it is also expensive and impractical. Capnography provides a useful, and practical, means to monitor patient PCO₂, and is recommended for all anesthetized patients undergoing mechanical ventilation under general anesthesia.
• There are two categories of capnographs: main-stream, which analyzes the patient’s exhaled breath adjacent to the endotracheal tube, and side-stream, which removes a sample of the patient’s breath and delivers it to an analyzer away from the patient.
• Capnography is based on the principle that end-tidal exhaled PCO₂ (PₑₜCO₂) is roughly equal to pulmonary arterial PCO₂ (PaCO₂)
• Graphical illustration of the PₑₜCO₂ over time is called a capnogram. Capnograms are useful for visually monitoring an anesthetized patient’s PCO₂ and other problems that can develop, such as a leak in the breathing system.

Final considerations
• A patient’s delivered Vₜ should be set according to a desired PIP and PₑₜCO₂ rather than to the calculated Vₜ.
• Maximum PIP for small animal patients is 20 cm H₂O; otherwise, barotrauma could occur to the patient’s pulmonary tissues (alveoli).
• IPPV causes a decrease in mean arterial pressure due to a reversal of the physiological thoracic blood pump.
• Positive end-expiratory pressure can be used to help facilitate oxygenation via maintaining opened alveoli.

References
Complications and Troubleshooting During Anesthesia and Your Best Anesthetic Monitoring Options
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- Complications that can occur during small animal anesthesia range from minor annoyances to major, life threatening events.
- Troubleshooting intra-operative anesthetic problems begins with pre-anesthetic planning and anticipating possible adversities.

Small animal pre-anesthetic preparation
- Preparation is the key to successful anesthetic outcomes. Anesthetic preparation includes equipment upkeep such as vaporizer calibration, and breathing system and machine leak checks. Monitoring equipment should be kept clean and in good working order.
- The anesthetic record is considered a legal document, an integral component of a patient’s complete medical record, and is signed by a licensed veterinarian. The anesthetic record chronologically should record all events that occur during the anesthetic procedure, including complications.
- Having one person dedicated to patient monitoring during the anesthetic procedure is an important contribution toward avoiding intra-operative complications.

Complications related to anesthetic drugs
- All anesthetic drugs are potentially harmful or fatal.
- No anesthetic drug is perfect for a specific patient or procedure. Unpredictable patient response to anesthetic drugs should always be considered a potential complication.
- All anesthetic drugs given to a patient, including mistaken administrations, should be recorded in the patient’s anesthetic record in milligram or microgram per kilogram form.
- A thorough, working knowledge of anesthetic drugs, their combinations, and their pharmacodynamics in multiple animal species is absolutely essential in order to help secure safe and reliable veterinary anesthetic procedures.

Complications: Pre- to early anesthetic period
- Anesthetizing an animal patient to the point of loss of righting reflex (stage 3 anesthesia) abolishes the gag and swallowing reflexes requires intubation. Without proper intubation, an anesthetized patient risks aspiration pneumonia, severe esophagitis, upper airway obstruction, and inadequate ventilation and oxygenation.
- Tracheal intubation issues can be related to esophageal intubation, improper endotracheal tube size, and endotracheal tube cuff leaks.
- On rare occasions, a vagal reflex can occur during endotracheal intubation. Stimulation of the parasympathetic fibers in the larynx can initiate a vagovagal response which, in-turn, causes a sudden increase in vagal tone, clinically seen as a dramatic, sometimes lethal, bradycardia.
- Hypoxia shortly after induction can be related to anesthetic drug-related apnea, respiratory disease, inadequate fresh gas flow, inadequate oxygen delivery (empty O2 tank) or disconnected patient breathing system or common gas outlet.
- During the induction a patient may awaken suddenly or struggle. Stage 2 anesthesia during induction can be related to inadequate pre-anesthetic medications, improper induction procedure, improper ET intubation, and lack of inhalant anesthetic administration.
- Hypoventilation is defined as a PCO2 greater than 50 - 60 mmHg. An anesthetized patient on 100% O2, and breathing spontaneously 2 breaths per minute will have adequate oxygenation but severe hypoventilation.
- Oxygenation is a poor indicator of ventilation.

Complications: Anesthesia period
- Most anesthetic drugs cause a dose-dependent depression of both the peripheral chemoreceptor responses and the central respiratory ventilatory drive, therefore; hypoventilation is a common patient complication during general anesthesia.
- Watching chest wall or reservoir bag movement and/or lung auscultating confirms the patient is breathing and provides a respiratory rate; however, these parameters do not adequately assess ventilation. In order to adequately monitor a patient’s ventilation, CO2 must be quantified.
• End-tidal PCO2 (P \textsubscript{E}CO\textsubscript{2}) is an effective means to monitor anesthetized patient ventilation (PaCO\textsubscript{2}). P \textsubscript{E}CO\textsubscript{2} is based on the principle that the end-tidal, alveolar PCO\textsubscript{2} (PACO\textsubscript{2}) is equivalent to pulmonary arterial PCO\textsubscript{2} (PaCO\textsubscript{2}). Patients receiving IPPV should be monitored using P \textsubscript{E}CO\textsubscript{2}.

• Cardiac arrhythmias can occur unexpectedly in normal, healthy anesthetized patients. Electrocardiogram does not evaluate adequately cardiac function; however, it does provide an assessment of electro-myocardial conduction and heart rate. Electro-myocardial conduction (ECG waveform) does not indicate myocardial contraction; however, myocardial contraction (pulses, etc.) necessarily indicates electrical conduction.

• Anesthetic drugs, especially inhalant anesthetics, cause a dose-dependent depression of vasomotor tone. Patient blood pressure monitoring during general anesthesia is necessary to assess adequately systemic arterial pressures. Mean arterial blood pressure (MAP) is an indirect evaluation of tissue perfusion. Hypotension, low MAP, can be caused by poor cardiac output, hypovolemia, and vasodilation. The primary cause of patient hypotension during general anesthesia is excessive anesthetic depth causing poor cardiac output and/or vasodilation. Hypertension, elevated MAP, can be caused by inadequate anesthesia, analgesia, diseases (pheochromocytoma), or certain anesthetic drugs (alpha 2 agonists).

• Anesthetic depth should be assessed using multiple factors rather than relying on one or two parameters (jaw tone, eye position, response to stimulus, respiratory rate, blood pressures, etc.). Patients that lack anesthesia may have coordinated muscle movement and signs of increased sympathetic tone. Inadequate anesthesia means a patient is reversing from stage 3 anesthesia back into stage 2 anesthesia; therefore, the patient requires more anesthetic (injectable and/or inhalant) to maintain surgical unconsciousness. Anesthetized patients that lack analgesia are those with uncoordinated muscle movements (reflexes) and/or those that require large doses of anesthetics to maintain stage 3 anesthesia (>2% isoflurane, repeated doses of propofol), which risks the loss of sympathetic tone (hypotension). Patients that lack analgesia during anesthesia require a MAC reducing modality such as a mu agonist opioid or locoregional block.

• Hypothermia is the primary complication during general anesthesia. Anesthetic drugs cause a dose dependent depression of the thermoregulatory centers and blunt the body’s response to cold environments. Untreated hypothermia can lead to increased vagal tone, bradycardia, delayed recoveries, and poor drug metabolism.

• Intra-operative patient death is the most extreme anesthetic-related complication. Most anesthetic deaths in veterinary medicine occur post-operatively within the first 3 hours. When signs of onset of acute death are observed during general anesthesia, the following steps should be indicated: confirm cardiac arrest, turn-off and reverse all anesthetic drugs, and begin CPR.

References
Analgesic Considerations in Cats
Andrew Claude, DVM, DACVAA
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- The pharmacokinetic and pharmacodynamic effects of anesthetic and analgesic drugs differ between dogs and cats. Cats are NOT small dogs.
- Unfortunately, analgesic options for feline patients are limited compared with analgesic options for canine patients.

Important points regarding feline patients
- Due to feline aloof behavior, it can be difficult for clients to notice subtle changes with their cat’s health. Cats typically do not show obvious signs of pain; instead, they become withdrawn and hide.
- Generally speaking, feline responses to anesthetic and analgesic drugs are unpredictable compared with canine responses.

Physiology of nociception and feline pain
- Transduction: Mechanical, chemical, or thermal injury is converted to an electrical impulse by Aβ (quick pain) and C nociceptors (slow pain).
- Transmission: The noxious electrical impulse is transmitted from the periphery to the spinal cord via Aβ and C sensory neurons. The synapse between the sensory neurons and the spinal cord occurs at lamina II (substantia gelatinosa) in the dorsal spinal horn.
- Primary (spinal) modulation: Within the spinal cord the afferent, noxious sensory impulse undergoes initial analysis. The spinal cord upgrades or downgrades the severity of the noxious stimulus and communicates that information to the brain. An unconscious reflex arc is the result of primary (spinal) modulation.
- Projection: After primary modulation, the noxious information is then projected to the brain via several tracts: two examples are the spinocervicothalamic (fast pain) and spinoreticular (slow pain) tracts.
- Secondary (cerebral) modulation: Within the conscious brain noxious afferent input is perceived as pain. Unconsciousness (anesthesia) blunts, or abolishes, secondary nociceptive modulation.
- Providing analgesics before surgery is called pre-emptive analgesia. Studies have shown that preemptive analgesia significantly decreases the likelihood of hypersensitivity associated with surgical pain.
- Preventive analgesia is term that describes a comprehensive pain control plan which includes pre-, intra- and postoperative therapies. Preventive analgesia has been well established in human medicine but not yet in veterinary medicine.
- The Brondani multi-dimensional composite feline pain scale was recently validated for the English language. Before the Brondani feline pain scale there was no validated pain scale for cats.
- Pain is not always considered a major component of many feline diseases. Saddle thrombosis, for example, is a clinical condition secondary to feline cardiac disease and causes extensive, acute ischemic muscle pain. Regardless of the disease, pain evaluation, and therapy, should always be part of the clinical plan.
- Identifying pain in cats can be difficult. Cats do not outwardly express pain. Sometimes an owner noticing a change in his or her cat’s behavior is the only indication of discomfort. Clinical signs of acute pain in cats include a tucked or crouched posture, reluctance to move, ears facing forward, focused eyes, lip licking, guarding, and purring.

Analgesic options for feline patients
- Opioids are considered the backbone of analgesia in both human and veterinary medicine. Mu agonist opioids have been known to cause opioid-related hysteria (dysphoria) and hyperthermia in cats. Although both conditions merit concern their clinical relevance is questionable and both can be reversed using naloxone. Morphine and hydromorphone are mu agonist opioids that are most likely to cause side effects in cats whereas oxymorphone, methadone, and fentanyl are the least likely.
- Butorphanol is a mu antagonist, kappa agonist opioid and has good effects in cats; however, its duration of action is only 30 – 45 minutes.
- Buprenorphine is a partial mu agonist opioid and, in cats, provides excellent analgesia for up to 6 to 8 hours in cats.
- Alpha 2 agonists provide both sedation and analgesia. Dexmedetomidine is an excellent major tranquilizer for cats because it provides predictable results, good analgesia, can be combined with other drugs, and is the choice tranquilizer for cats with hypertrophic cardiomyopathy (HCM).
• Dissociative NMDA antagonists (ketamine, tiletamine) also provide consistent sedation and analgesia in cats; however, this family of major tranquilizers is contra-indicated in cats with HCM.
• NSAIDs are good analgesic choices in healthy cats. It is recommended practitioners administer these drugs judiciously, monitor their patients closely, and communicate to their clients regarding potential adverse side effects from NSAIDs.
• In addition to parenteral analgesics, locoregional techniques can be extremely valuable when used for pain management in cats. Examples of common locoregional procedures in cats include nerve blocks of the mouth and eyes, brachial plexus blocks, forepaw and rear-paw ring blocks, and lumbosacral and caudal epidurals.

References
• Local and regional anesthesia are common practices in large animal veterinary medicine. In the past, locoregional techniques have been underutilized in small; however, recently there has been a surge in their use with small animal practice.
• Most common locoregional anesthetic techniques used for large animal surgery can also be adapted to small animals.
• A good understanding of basic anatomy, pharmacology of local anesthetic drugs, and patient physiology is essential in order to safely, and effectively, utilize local and regional anesthetic techniques.
• Combining local and regional anesthetic techniques with parenteral analgesics can provide small animal practitioners more flexibility and better options for pre-, intra- and post-operative pain management.

Physiology of and concepts regarding pain
• Acute pain is considered a normal, healthy, and protective physiological response to noxious stimuli. Chronic, centralized pain, or wind-up pain is considered a pathological, abnormal expression of pain.
• The dose of general anesthetics needed to abolish the effects of nociception is close to that which can abolish autonomic responses. High doses of general anesthetic drugs significantly depress the cardiovascular, respiratory, and thermoregulatory systems in the body. Analgesic modalities before, and during, surgery help decrease the dose of general anesthetics needed to provide immobility without loss of autonomic tone.
• Transduction: Mechanical, chemical, or thermal injury is converted to an electrical impulse by Aβ (quick pain) and C nociceptors (slow pain).
• Transmission: The noxious electrical impulse is transmitted from the periphery to the spinal cord via Aβ and C sensory neurons. The synapse between the sensory neurons and the spinal cord occurs at lamina II (substantia gelatinosa) in the dorsal spinal horn.
• Primary (spinal) modulation: Within the spinal cord the afferent, noxious sensory impulse undergoes initial analysis. The spinal cord upgrades or downgrades the severity of the noxious stimulus and communicates that information to the brain. An unconscious reflex arc is the result of primary (spinal) modulation.
• Projection: After primary modulation, the noxious information is then projected to the brain via several tracts: two examples are the spinocervicothalamic (fast pain) and spinoreticular (slow pain) tracts.
• Secondary (cerebral) modulation: Within the conscious brain noxious afferent input is perceived as pain. Unconsciousness (anesthesia) blunts, or abolishes, secondary nociceptive modulation.
• Animals and humans share similar anatomical and physiological nociceptive structures for the production, conduction, and modulation of pain.
• Pain assessment in animals is based on anthropomorphic comparisons, subjective, and objective criteria.
• Pain is the conscious perception of nociception. Nociception is the physiological processes that involves the conversion of a noxious stimulus to an electro-chemical impulse and modulation in the CNS.
• The perception of pain does not occur during general anesthesia; however, without analgesic modalities the process of nociception still occurs, which can lead to centralized, or wind-up pain.
• Providing analgesics before surgery is called pre-emptive analgesia. Studies have shown that preemptive analgesia significantly decreases the likelihood of hypersensititity associated with surgical pain.
• Preventive analgesia is a term that describes a comprehensive pain control plan that includes pre-, intra- and postoperative therapies. Preventive analgesia has been well established in human medicine but not yet in veterinary medicine.

Local and regional anesthetic techniques in small animal practice
• Lidocaine and bupivacaine are the most common local anesthetics used in small animal practice.
• Local anesthetics are fast-sodium channel blocking agents. In their bottles local anesthetics are acidic and inactive. When injected into the body (comparatively alkaline), the local anesthetic molecules dissolve into HCl salts and active bases. The active bases diffuses across the nerve epineurium and cell membrane into the cytoplasm and block sodium channels.
• Toxic effects of local anesthetic depend on the drug. Lidocaine causes dose-dependent neuro- and cardio-toxic effects. Bupivacaine has potent cardio-toxic effects. Inadvertent intravenous injection of local anesthetics must be avoided; therefore, always aspirate before injecting.
• Most locoregional anesthetic techniques can be performed blindly; however, a peripheral nerve locating device (nerve stimulator) can help increase the success and safety of the procedures.
• Quincke needles are designed specifically for locoregional techniques. Quincke needle bevels are blunter which allows for a better feel as the needle dissects through tissue planes.
• Common regional techniques for dental procedures include mental, infra-orbital, maxillary, and mandibular nerve blocks. Auriculopalpebral and the greater auricular nerve blocks can be useful for procedures involving the ear such as, ear flushes and surgery.
• The brachial plexus infiltration block can be used for surgeries involving the distal forelimb. A carpal ring block can be used for surgeries involving the forepaw such as declaws and digit amputations.
• Lumbosacral epidural regional techniques are very useful for surgeries involving the hips and distal rear legs. The most common drugs used for lumbosacral epidurals is the combination of preservative free (PF) morphine and PF bupivacaine. Feline lumbosacral epidurals using PF morphine and PF bupivacaine can be done also; however, it is important to remember the feline spinal cord ends at S1 compared with the canine spinal cord, which ends at L5-6.
• Caudal epidural techniques can be used to provide regional anesthesia during perineal surgeries and facilitate urethral relaxation for catheter placement in blocked male cats.
• Infiltration catheters (soaker catheters) have manufactured fenestrations at their distal ends so that, when buried in the surgical wound, local anesthetics can be injected into the tissues providing a field of anesthesia.

References
Acute Pain Management: Pharmaceutical Options
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- Systemic analgesic drugs are the mainstay of small animal veterinary pain management.
- Options regarding parenteral analgesics in small practice are often governed by cost and clinician experience.
- Utilizing the same analgesic drugs, regardless of the surgical procedures, is not good analgesic case management. Having a good understanding of a variety of analgesic options, for dogs and cats, can be a valuable addition to help expand clinical practice.

Rules of thumb
- Animals share similar anatomical and physiological nociceptive properties as humans; therefore, animals likely have similar pain experiences as humans.
- Pain in animals is difficult to quantify and evaluation is based on a combination of objective and subjective anthropomorphic attributes.
- Pain is the conscious perception of nociception. General anesthesia abolishes consciousness; therefore, pain is not perceived during general anesthesia. Nociception is the physiological process by which a noxious stimulus is transduced into an electro-chemical impulse and carried to the central nervous system. Nociceptive, physiological processes continue to occur during general anesthesia unless analgesics are employed.
- According to the Veterinarian’s Oath, veterinarians have an obligation to prevent and relieve animal suffering, including pain.
- If there is a suspicion an animal patient is painful, it is better to treat for pain than to ignore the concern.

Concepts regarding nociception and pain management in veterinary patients
- Transduction: Mechanical, chemical, or thermal injury is converted to an electrical impulse by Aβ (quick pain) and C nociceptors (slow pain).
- Transmission: The noxious electrical impulse is transmitted from the periphery to the spinal cord via Aβ and C sensory neurons. The synapse between the sensory neurons and the spinal cord occur at lamina II (substantia gelatinosa) in the dorsal spinal horn.
- Primary (spinal) modulation: Within the spinal cord the afferent, noxious sensory impulse undergoes initial analysis. The spinal cord upgrades or downgrades the severity of the noxious stimulus and communicates that information to the brain. An unconscious reflex arc is the result of primary (spinal) modulation.
- Projection: After primary modulation the noxious information is then projected to the brain via several tracts; two examples are the spinocervicothalamic (fast pain) and spinoreticular (slow pain) tracts.
- Secondary (cerebral) modulation: Within the conscious brain noxious afferent input is perceived and translated into pain. Unconsciousness (anesthesia) blunts, or abolishes, secondary nociceptive modulation.
- Providing analgesics before surgery is called pre-emptive analgesia. Studies have shown that preemptive analgesia decreases significantly the likelihood of hypersensitivity associated with surgical pain.
- Preventive analgesia is term that describes a comprehensive pain control plan, which includes pre-, intra-, and postoperative nociceptive therapies. Preventive analgesia has been well established in human medicine but not yet in veterinary medicine.
- Analgesic drugs help reduce/abolish pain by interfering with the nociceptive process(es).
- The dose of general anesthetics needed to produce unconsciousness is far less than what is required to abolish the effects of nociception. The dose of general anesthetics needed to abolish the effects of nociception is close to that which can abolish autonomic responses. High doses of general anesthetic drugs significantly depress the cardiovascular, respiratory and thermoregulatory systems in the body. Analgesic modalities before, and during, surgery help decrease the dose of general anesthetics needed to provide immobility without loss of autonomic tone.
- A pre-emptive pain scale evaluation can help the clinician formulate a patient’s analgesic therapy plan. A pre-emptive pain scale is a subjective pain assessment done pre-operatively based on the anticipated degree of pain. Analgesic drug potency, dose, and frequency of administration can be tailored according to the pre- and post-operative pain evaluation.
Parenteral analgesics in veterinary small animal practice

- Common concerns with parenteral analgesic drugs in small animal practice include unwanted sedation, extra expense, controlled drug issues, unpredictable results, drug knowledge of the attending veterinarian, and client compliance.
- Opioids are the primary parenteral analgesic used for human and veterinary surgery. Mu agonist opioids are an excellent choice to help provide effective pre- intra- and post-operative pain relief for animal patients. There are many mu agonist opioid drugs available, including opioid products that are absorbed transdermal.
- Butorphanol, a mu antagonist, kappa agonist opioid, has limited analgesic capabilities and a short duration of action. Butorphanol should not be considered a primary analgesic for surgical pain, especially in dogs.
- Buprenorphine is a partial mu agonist opioid, has a good analgesic profile, and long duration of action for both dogs and cats.
- NSAIDs relieve pain via their anti-inflammatory abilities making them extremely versatile analgesic drugs. There are many NSAID options for both dogs and cats; however, judicial use of these drugs should be limited to normal, healthy patients. Contraindications for NSAID include concurrent steroid administration, concurrent other NSAIDs, renal and hepatic diseases, gastrointestinal diseases, coagulopathies, pregnancy, dehydration, and other circulatory diseases.
- Common, and effective, adjunctive analgesic choices include lidocaine, ketamine, and alpha 2 agonists.

References
Pain Medication: A Win, Win Situation for You, Your Patients, and Your Clients
Andrew Claude, DVM, DACVAA
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Mississippi State, MS

• Historically, it was believed animals did not feel pain or perceived pain differently than did humans. An example of a misconception regarding post-operative pain in animal patients was that pain following surgery benefited animals because it limited movement thus preventing further injury.
• Animals and humans share similar anatomical and physiological nociceptive structures for the production, conduction, and modulation of pain.
• Pain assessment in animals is based on anthropomorphic comparisons, subjective, and objective criteria.

Ethical principles of pain management in veterinary medicine
• The Veterinarian’s Oath states, “…the protection of animal health and welfare, the prevention and relief of animal suffering...” Does the Veterinarian’s Oath still apply today?
• Since recorded history humans have consistently demonstrated a keenness toward domesticating and caring for animals. Unfortunately, the historical relationship between humans and animals is tainted with various forms of animal cruelty.
• Modern biology presented similarities between humans and animals, thus proving animals were not distinct from humans.
• Charles Darwin’s theory of evolution transformed the perception of the relationship between animals and humans.
• In United States, the 1966 Animal Welfare Act and The National Institutes of Health Reauthorization Acts set the stage for social, economic, and legislative actions leading to the modernization of the concept of animal welfare.
• As modern medicine became more scientifically based, pain, although always recognized as an entity of pathology, was difficult to accept because it never completely had a scientific explanation.
• Veterinary medicine was founded originally to benefit the animal agricultural industry and military use of horses. Anesthesia and analgesia were primarily means to help control large animals, protect personnel, and the value of the patient.
• Although human medicine has made tremendous advancements in pain management veterinary medicine still lags behind.
• Society’s views of animal pain and welfare have changed dramatically since the Animal Welfare Act was passed in 1966. Today, society no longer tolerates unnecessary animal suffering. The ease of information from the world-wide internet allows people to self-educate on subjects in pet health and welfare. Clients no longer consider pain management options as a luxury for their pet but instead as a mandatory part of an overall procedure.
• Two primary factors that will contribute to the veterinary industry losing significance in society are refusal to change and refusal to charge. Each one of us, as a representative of the veterinary industry, has an obligation to remain educated regarding pet health issues (including pain management), and be the primary source of information about pet welfare for clients, and clients have an obligation to realize financially the importance of veterinarians’ expertise in the health and welfare of their pets.

References
ACVAA website: http://www.acvaa.org, American College of Veterinary Anesthesiologists’ position paper on the treatment of pain in animals, 2006 http://www.acvaa.org/docs/Pain_Treatment
Avian respiratory medicine
Respiratory disease is relatively common in companion birds. A successful treatment outcome relies on a rapid diagnosis, yet understanding the complexities of the anatomy and physiology of the respiratory system and respiration and birds can be challenging. The avian respiratory system differs greatly from mammalian species, and these differences pose significant challenges to the diagnosis and treatment of respiratory disease in birds.

Before getting started, first observe the bird carefully from a distance for evidence of dyspnea such as tail bobbing, wing flaring, extending of the neck, and open-mouth breathing. Observe for coughing and sneezing and changes in the character of the voice. All birds will become stressed during handling restraint, which can greatly increase the respiratory rate and effort. Observe how quickly the bird recovers from handling.

Upper respiratory tract
The upper respiratory tract in birds consists of the nasal cavity and infraorbital sinus. For the purpose of this presentation, the larynx and glottis will be discussed in the lower respiratory tract section.

Nasal cavity
Anatomy
The avian nasal cavity consists of the nostrils (external nares), opercula, nasal septum, nasal conchae (rostral, middle, and caudal), and choana. In parrots, the nares are typically located dorsolaterally at the base of the maxillary beak. In budgerigars (Melopsittacus undulatus) and a few other psittacine species, a section of raised, colored skin called the “cere” surrounds the nares. Just within the nostril opening, a keratinized vascularized flap of tissue called the operculum is visible. Within the nasal cavity, the cartilaginous to bony nasal septum and conchae direct the flow of air ventrally towards the choanal slit and caudally to enter the infraorbital sinus. The movement of air through the nasal cavity allows for olfaction, air filtration, water conservation, and thermoregulation. The choanal slit in psittacine species is rimmed with papillae, which is believed to help prevent food from entering the nasal cavity.

Examination and diagnostic tests
Inspect the nares with a bright light and magnification. Observe for swelling, redness, distortion, discharge, matted feathers, and obstruction from debris or foreign material. Examine the choanal slit and papillae for swelling, redness, bleeding, foreign objects, and blunting of the papillae. The most useful diagnostic test to evaluate the nasal cavity is the nasal flush, which can be both diagnostic and therapeutic. Approximately 2 to 5 ml/kg of warm buffered crystalloid solution (eg. sterile saline) is instilled into each nostril while the head of the bird is directed downwards to prevent aspiration. Fluid can be collected into a sterile container as it drains through the choanal slit into the oral cavity. Fluid should also flow through the contralateral nostril. Resistance to flow suggests obstructive disease. Examine the collected fluid for blood, mucus, and purulent debris. The fluid can be further evaluated through cytology and special stains and microbiologic culture. A swab can also be collected from the rostral sulcus of the choanal slit. Plain and contrast skull radiography and advanced imaging such as computed tomography (CT) and magnetic resonance imaging (MRI) can be helpful in assessing the bony and soft tissue structures of the avian nasal cavity.

Selected diseases and treatments
Rhinitis
Inflammatory and infectious disease of the nasal cavity. Bacterial and mycotic rhinitis are common in companion birds. Viral infections such as pox and herpesvirus are less common. Hypovitaminosis A, common in parrots fed a seed-based diet, causes squamous metaplasia of epithelial linings including those of the nasal cavity, predisposing to opportunistic infections. Other causes include nasal foreign bodies, trauma, and neoplasia. Clinical signs include sneezing, matted feathers around the nares, redness and swelling or occlusion of the nares, and sinus flaring. Chronic infections can lead to disfiguration of the nares and beak. Treatment options include nasal irrigation and debridement, topical or systemic antimicrobials based on results of culture and sensitivity, and dietary modification.

Rhinoliths
Nasal concretions of debris and infectious agents such as fungal organisms and opportunistic bacteria. Hypovitaminosis A is believed to be a predisposing factor. Rhinoliths are often chronic and insidious and can erode through musosal linings and bone into the infraorbital sinus. Clinical signs include nasal swelling and occlusion, as well as epiphora from lacrimal gland obstruction and sinus flaring. Rhinoliths can become mineralized and visible on survey radiographs. Rhinoliths can be manually debrided. Sedation or anesthesia is advised for larger rhinoliths. Cultures should be done and antimicrobial therapy is generally advised, based on sensitivity results. Erosions to the nasal cavity and sinus are permanent, and birds are prone to recurrent debris accumulation and opportunistic
infections. Birds should be returned for periodic monitoring, and clients can be instructed on how to perform periodic nasal irrigation at home.

**Choanal atresia**
Congenital imperforate communication between the nasal cavity and choana. Most often reported in African grey parrots (*Psittacus erithacus*). Clinical signs include chronic nasal drainage and opportunistic infections. Diagnosis is best made through contrast skull radiography or advanced imaging. Treatment is surgical with appropriate antibiotic therapy.

**Infraorbital sinus**

**Anatomy**
The nasal cavity communicates caudodorsally with the infraorbital sinus through small openings. There is a single infraorbital sinus on each side, but there are numerous diverticulae, including the rostral, preorbital, infraorbital, postorbital, and mandibular diverticulae. Caudally, the infraorbital sinus communicates with the cervicocephalic air sac, which is not involved in gas exchange. The right and left infraorbital sinuses communicate in psittacine species.

**Examination and diagnostic tests**
Observe for flaring of the preorbital diverticulae with breathing. Observe for periorbital and preorbital sinus swelling. Palpate these areas for masses or fluid accumulation. The most useful test to evaluate the infraorbital sinus is the sinus aspiration and lavage. A small gauge hypodermic or butterfly needle is inserted into the preorbital diverticulum dorsal or ventral to the jugal arch. An oral speculum can be used to increase the size of the space. Fluid can be aspirated, or instilled and drained for diagnostic purposes. Radiography, ultrasonography, and advanced imaging such as CT and MRI can also be useful in the diagnosis of sinus disease in birds.

**Selected diseases and treatments**

**Sinusitis**
Inflammatory and infectious disease of the nasal cavity. Similar etiology to rhinitis, often occurs simultaneously with rhinitis. Clinical signs can include sneezing and nasal discharge, facial swelling, sinus flaring with breathing, periorbital swelling, and epiphora. Treatments often include systemic antimicrobial therapy, sinus irrigation, and sinus surgery.

**Sinoliths**
Concretions of cellular debris and infectious agents can accumulate in one or more of the sinus cavities. Over time these concretions can become mineralized. Surgical removal has been described, although surgery can prove challenging and require bony trephination for sinoliths in the rostral diverticulum.

**Cervicocephalic air sac hyperinflation**
While not a true disease of the infraorbital sinus, it is often associated with occlusion of the communication with the sinus. Hypovitaminosis A is believed to be a predisposing cause. Clinical signs include an air-filled swelling of the neck, and often these swellings can be enormous. The swelling must be differentiated from crop dilation. The swelling is not considered painful and can be left alone, or punctured and temporarily glued open. Stent placement has been described but often quickly fails.

**Lower respiratory tract**
The lower respiratory tract consists of the larynx and rima glottis (for this discussion), trachea, syrinx, lungs, and air sacs.

**Anatomy and respiration**
The opening of the larynx, or rima glottis, lacks an epiglottis in birds. The larynx does not produce sound; rather, the syrinx at the bifurcation of the trachea to the primary bronchi performs this task. The larynx lies up against the choana during breathing at rest, allowing air to flow through the nasal cavity and choanal slit into the trachea. Tracheal rings are complete in birds, unlike mammals, and can ossify in some adult birds, even to the point of containing marrow. The lungs are rigid and do not expand. There are four paired air sacs (cervical, cranial and caudal thoracic, and abdominal) and one unpaired air sac (clavicular). The air sacs are thin walled and are not involved in gas exchange. Some bones such as the humeri are pneumatized and communicate with the air sacs through diverticulae. Birds lack a diaphragm, and inspiration and expiration are active events.

Respiration is a two-breath system in birds. During inspiration, half of the inspired breath of air moves into the lungs without gaseous exchange (neopulmonic parabronchi) and the other half moves into the caudal air sacs. Air that is already in the lungs moves into the cranial air sacs. During expiration, air moves from the caudal air sacs into the lungs (paleopulmonic parabronchi) for gas exchange, and air in the cranial air sacs leaves through the trachea. Cross-current exchange of gas occurs between the air and blood capillaries, which is a highly efficient system in birds for exchanging oxygen and carbon dioxide.

**Examination and diagnostic tests**
Observe the larynx and rima glottis with a bright light and magnification. If necessary, gauze loops can be used to open the beaks. Palpate the cervical trachea. Auscult the coelomic cavity over the keel and over the back. A tracheal wash with 0.50 to 1.0 ml/kg of sterile saline solution can be useful to collect diagnostic samples of the trachea, syrinx, and primary bronchi. These airways can often be visualized endoscopically. A rigid 1.9- or 2.7-mm telescope can be used to visualize the trachea in syrinx in birds greater than 200 grams body weight. A bronchoscope can occasionally be of use in larger birds. An air sac cannula is often necessary to provide gas
anesthesia and oxygen during airway endoscopy. Laparoscopy is useful to assess the lungs and air sacs and to collect diagnostic specimens such as lung biopsies. Survey radiographs are very useful in assessing the lower respiratory system in birds.

**Selected diseases and treatments**

**Tracheal obstruction**

Occasionally birds will aspirate seed hulls or whole seeds, which can become lodged in the trachea. Fungal granulomas will often grow within the lumen of the larger airways, causing obstruction. Transilluminate the trachea to screen for a tracheal foreign body. Obstructions rarely are visible on survey radiographs; endoscopy is the diagnostic tool of choice and can also be used to debride fungal granulomas or remove foreign objects. An air sac cannula may be necessary to bypass the larger, obstructed airways.

**Aspergillosis**

Opportunistic fungal infections in the airways, lungs, and air sacs are not uncommon and usually associated with *Aspergillus* spp. Birds can be affected by the mechanical obstruction of a granuloma in a larger airway or be systemically ill due to circulating mycotoxins. Definitive diagnosis is through collection of plaques and granulomas and lung biopsy, and cytology and culture. Tracheal wash samples are often negative for infection. Treatment options include debridement and local and systemic antifungals. The prognosis is generally guarded at best.

**Chronic obstructive pulmonary disease (COPD)**

Also known as macaw pulmonary hypersensitivity, macaw asthma, macaw polycythemia, and macaw pneumonitis, this disease is most commonly seen in blue and gold macaws (*Ara ararauna*). Relative secondary polycythemia is a common finding. Exposure to powder-producing birds such as cockatoos (*Cacatua* spp.) and African grey parrots is believed to be a predisposing cause. Clinical signs include exertional dyspnea, cyanosis, and a dry, non-productive cough. Definitive diagnosis is through endoscopic lung biopsy. Treatment is aimed at improving air quality, removing potential allergens, treating secondary opportunistic infections. Prolonged treatment with systemic corticosteroids is not generally advised in birds due to the risks of severe immunocompromise.

**Chronic pulmonary interstitial fibrosis (CPIF)**

Chronic pulmonary interstitial fibrosis (CPIF) is a chronic, progressive disease reported in Amazon parrots (*Amazona* spp.) and other psittacine species associated with loss of normal pulmonary architecture due to pulmonary inflammation and fibrosis and congestion of pulmonary capillaries. These changes result in large, air-filled caverns in the pulmonary tissue. Reported clinical signs include exercise intolerance, and relative polycythemia is common. The etiology is unknown, although airborne toxins, hypersensitivity disease, and viral infections have been speculated as possible causes associated with CPIF. Diagnosis is rare pre-mortem, although a lung biopsy should be diagnostic. No effective treatments have been reported.

**Neoplasia**

A number of respiratory neoplasms have been reported in birds. Moluccan cockatoos (*Cacatua moluccensis*) appear over-represented for a form of air sac cystadenocarcinoma that invades through the wall of the humerus, forming a cystic mass under the skin in the axillary region. Cockatiels (*Nymphicus hollandicus*) appear susceptible to a unique undifferentiated carcinoma of pulmonary or thymic origin. Other respiratory neoplasms have been reported in birds, including bronchogenic carcinoma and pulmonary fibrosarcoma.

**Suggested reading**


Avian Ophthalmology
Lauren Powers, DVM, DABVP
Carolina Veterinary Specialists
Huntersville, NC

Avian ophthalmology
Free ranging birds are highly dependent on accurate vision in order to capture prey and forage, to avoid predators, and to find suitable perches and shelter. Perfect, or near-perfect, ocular health is imperative to survival for most free living avian species. While perfect vision is less vital for the captive companion parrot, it is nevertheless important to recognize and treat ocular disease for the overall health and comfort of the bird. Reported prevalence of ocular disease in birds ranges from 7.6% to up to 26% in birds of prey.

Ocular anatomy

Ocular adnexa
Birds possess two major eyelids. The lower eyelid moves more than the upper eyelid and covers most of the globe when the eye is closed. The eyelids lack Meibomian glands. The third eyelid sweeps components of the tear film produced by the lacrimal gland and Hardarian gland over the eye, and pulls debris and remaining tear film into the puncta of the lacrimal duct. The pyramidalis muscle loops through a sling formed by the quadratus muscle to close the third eyelid, much like the swinging of a pendulum.

Ocular globe
The orbit is open and the ocular globe is comparatively very large in birds. Globe shape varies widely, with parrots having a somewhat flattened globe anterior to posterior. A ring of scleral ossicles helps support the enormous eye in the orbit and to support muscles used in vision accommodation. The iris is composed of striated (voluntary) muscle fibers, an important difference to the iris of mammals, which contains involuntary smooth muscle fibers. The retina is avascular in birds and there is no tapetum. A heavily pigmented portion of the choroid, the pectin, protrudes into the posterior vitreous to provide oxygen and nutrients to the retina. The pectin obscures the optic nerve from visualization. Most birds have a distinct fovea, or increased density of photoreceptors that yield enhanced visual resolution, and some species have two foveolae. Many avian species, particularly diurnal birds, are capable of detecting light in the ultraviolet spectrum (320 to 680 nm). There is complete decussation (cross-over) of the optic chiasm, and therefore birds do not demonstrate a true consensual pupillary light reflex.

Ocular examination
The ocular exam in a bird is similar to that mammals with a few minor differences. The minimum equipment necessary for ocular exam includes a fiber optic Finnoff transilluminator or a bright focused LED penlight, magnification, and a direct ophthalmoscope with a +25D or +40D lens. A slit-lamp biomicroscope is ideal to allow magnification and visualization of the smaller eyes of many species of birds. Indirect ophthalmoscopy using a lens size from 20D to 30D in large birds and up to 90D in smaller birds can allow visualization of a larger area of the fundus at a farther distance from the patient.

Topical parasympatholytic agents such as atropine are ineffective for inducing mydriasis in birds since the iridial muscle fibers are striated. Mydriasis can be achieved with heavy sedation or general anesthesia, or with topical or intercameral neuromuscular blocking agents (NMBA) such as d-tubocurarine. These drugs can have serious adverse effects if improperly used. Topical rocuronium bromide induced consistent mydriasis without noticeable adverse effects in European kestrels (Falco tinnunculus) in one study.

Selected ocular diagnostics

Tear tests
The Schirmer tear test (STT) and the phenol red thread test (PRTT) have been evaluated in avian species. Without topical proparacaine, the reported mean STT value was 7.9 ± 2.6 mm/min (range, 0 to 13 mm/min) in Hispaniolan Amazon parrots (Amazona ventralis) in one study. With proparacaine, the STT value was 5.1 ± 3.3 mm/min (range, 0 to 18 mm/min). The standard STT strip (normally 5 mm x 35 mm) is too wide to fit in the eyes of many avian species. The filter paper can be divided into two smaller sections, but there are no data on tear production values in birds using this modified STT technique.

Alternatively, the PRTT can be used. The PRTT utilizes a 75-mm long cotton thread impregnated with a pH sensitive phenol dye which is inserted into the ventral conjunctival fornix of the eye for 15 seconds. Unlike with the STT, application of proparacaine does not appear to interfere with PRTT results. In 24 Hispaniolan Amazon parrots, the PRTT was 12.5 ± 5.0 mm/min without proparacaine, which compared with 12.6 ± 5.4 mm with the topical anesthetic.

Fluorescein staining
Fluorescein staining is a very useful tool in avian ophthalmology. Topical fluorescein sodium combined with imaging using a cobalt blue light can reveal corneal damage such as ulceration, lacerations, and punctures, as well as obstructive diseases of the lacrimal apparatus.
Intraocular pressure measurement (tonometry)
Reference intervals for intraocular pressure (IOP) using applanation tonometry (eg. Reichert Tono-Pen Vet™ Applanation Tonometer, Dan Scott & Associates, Westerville, OH, USA) have been established in a number of avian species including parrots. In one study involving 275 birds with apparently healthy eyes, IOP results using applanation tonometry were between 9.2 and 16.3 mmHg. Reproducible readings have been reported in birds with a corneal diameter of at least 9 mm (the size of an Amazon parrot eye). Readings of eyes with corneal diameters of 5 mm or less (budgerigar range) are not reliable. Newer rebound tonometers (eg. TonoVET Tonometer, Jorgensen Laboratories, Loveland, CO, USA) are able to measure IOP through a cornea as small as 3 mm. Rebound tonometry has been assessed in several avian species such as flamingos and in several raptor species, but data are lacking for psittacine species. Topical anesthesia such as proparacaine is generally applied to the cornea about 10 to 15 seconds prior to IOP measurement.

Radiography, ultrasonography, and advanced imaging
Plain survey radiography can assess for soft tissue periorbital swelling and displaced skull fractures, but has minimal sensitivity for the detection of intraocular diseases other than fracture or displacement of the scleral rings. Evaluation of the ocular structures using standard ultrasonography equipment can be very helpful in visualizing intraocular chambers and structures and for detecting diseases within the surrounding orbit such retrobulbar abscesses or neoplasms. Retinal detachment can even be detected by ultrasonography in larger birds. Imaging through computed tomography (CT) and magnetic resonance imaging (MRI) can provide additional diagnostic information about the ocular globe and surrounding structures.

Cytology and microbiology
Swabs from the conjunctival sac and corneal scrapings can be collected for further evaluation such as cytology, Gram stain, acid fast stain, PCR, and microbiologic culture.

Advanced and emerging diagnostics
Electroretinography is useful in assessing retinal function in birds, but most practices do not possess the necessary equipment for this diagnostic modality. Photopic and scotopic flash electroretinograms (fERGs) were found to be clinically useful in evaluating retinal function in bald eagles (Haliaeetus leucocephalus) in one university study. 3D- and 4D color Doppler ultrasonography allow visualization of pectin blood flow and assess for posttraumatic lesion to the pectin. Ocular coherence tomography (OCT) is a highly sensitive interferometric, image-based technique that measures light reflected from ocular tissue layers. Two and three dimensional sections through the various ocular layers, such as cornea, lens, retina, and choroid, are displayed at almost histologic resolution.

Selected ocular diseases and treatments
Conjunctivitis
 Conjunctivitis is common in companion birds. Bacterial agents reported to cause blepharoconjunctivitis in birds include Mycobacterium spp., Chlamydia psittaci, Mycoplasma spp., Escherichia coli, Staphylococcus spp., Streptococcus spp., Pasteurella multocida, Pseudomonas aeruginosa, and Actinobacillus spp. in waterfowl. Almost any organism causing systemic infection can result in conjunctivitis. Viral agents include poxvirus, herpesvirus, goose parvovirus, papovavirus, and adenovirus. The spiruroid nematode parasite Oxyspirura mansoni has been associated with conjunctival irritation, pruritis, and epiphora in cockatoos, mynahs, and other birds. Trematode flukes (Philophthalmus spp.) can cause ocular irritation and have been associated with epiphora in ostriches. Disseminated cryptococcosis (Cryptococcus neoformans) can involve ocular structures. The author has seen fungal dacryocystitis secondary to topical corticosteroid administration in an Indian ring-necked parakeet (Psittacula krameri manillensis). Foreign bodies are frequently associated with conjunctivitis. Feathers, seed husks, and other debris can become lodged in the conjunctival sac or underneath the third eyelid and can cause significant discomfort and inflammation. The author has seen carpet fibers in a white bellied caique (Pionites leucogaster) migrate from the oral cavity into the lacrimal duct through the choanal cleft and into the eye, causing blepharospasm, epiphora, and conjunctivitis. Treatment is aimed at addressing the underlying cause. Broad-spectrum bactericidal antibiotics can be used, such as bacitracin-polymyxin B, neomycin, gentamicin, tetracycline, and fluoroquinolones such as ofloxacin and moxifloxacin.

Uveitis
 Uveitis in birds is most often associated with trauma, infections, immune-mediated diseases, and neoplasia. Blunt or sharp trauma can cause anterior or posterior uveitis and hemorrhage (hyphema). Hypopyon, fibrin clots, and damage to the scleral ossicles can also be seen. Infectious causes of uveitis include encephalomyelitis, Marek’s disease, reovirus, and poxvirus. Septicemia caused by any bacterial agent can be associated with uveitis. Clinical signs of anterior uveitis include photophobia, blepharospasm, corneal edema, aqueous flare, miosis, thickening or discoloration of the iris, and anterior or posterior synchiae. With posterior uveitis there may be retinal edema, hemorrhage, or detachment, or vitreous opacity. Treatment is aimed at the underlying cause as well as reduction of inflammation. Topical antibiotics and topical anti-inflammatory agents such as flurbiprofen are often used. Caution is advised for the use of topical corticosteroids such as prednisolone, especially for prolonged treatment periods, as they can be associated with local immunosuppression and secondary infections such fungal keratitis.
**Cataracts**

Cataracts are common in birds and are associated with advanced age, trauma, and genetics. Hereditary cataracts have been described in Yorkshire and Norwich canaries. Many companion birds blinded by cataracts can maintain a satisfactory quality of life. Lens luxation can be associated with cataracts in birds and is considered a potentially painful condition. Retinal detachment can also occur with mature or hypermature cataracts but is difficult to detect. Lens extraction through irrigation and aspiration or through phacoemulsification in larger birds can be performed and has been described in several avian species.

**Glaucoma**

Glaucoma is uncommonly diagnosed in birds, likely due in part with the challenges of recording IOP in the smaller avian species. However, glaucoma has been described in avian patients and can be associated with hyphema and uveitis such as lens-induced phacoclastic anterior uveitis. Use of topical and systemic medications for glaucoma have not been evaluated in birds. Because glaucoma is considered a painful condition, enucleation or ocular evisceration should be considered for birds clinically affected and with greatly elevated IOPs.

**Ocular neoplasia and xanthoma**

A variety of ocular and periocular neoplasms have been reported in birds, including retrobulbar adenocarcinoma, retrobulbar liposarcoma, lymphoma, periorbital cystadenoma, rhabdomyosarcoma, lipoma, and osteosarcoma, among others. Squamous cell carcinoma affecting the infraorbital sinus was associated with exophthalmos in a Solomon Island eclectus parrot (*Eclectus roratus solomonensis*). While not a true tumor, xanthomas have been described affecting the major eyelids, nictitans, and conjunctiva in psittacine species including Amazon parrots (*Amazona* spp.) and macaws (*Ara* spp), among others. Several publications reported successful surgical outcomes.

**Suggested reading**


Antimicrobial Therapy for Birds
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Antimicrobial therapy for birds
Antimicrobial agents are commonly used in avian practice for the treatment of certain infectious diseases. Despite limited pharmacokinetic and safety data in birds, it is still the clinician’s responsibility to administer, dispense, and prescribe the most effective and safe antimicrobial agent based on current evidence. Recent developments in avian antimicrobial therapy now offer minimally invasive or less invasive methods of treatment, including medicating of food and drinking water and slow-release formulations. Dosing strategies reported in this manuscript are greatly limited for the purposes of this discussion. Please refer to current drug formularies for a complete list of suggested dosages.

Selected antibiotic agents

- **Fluoroquinolones** – Bactericidal, concentration-dependent efficacy. Banned from use in food-producing animals such as poultry (eg. backyard chickens, Pekin ducks)
  - **Enrofloxacin** – Bactericidal against both Gram-positive and Gram-negative bacteria. Less activity against Gram-positive organisms. Poor efficacy against anaerobes. Occasionally used in the treatment of other avian bacterial diseases such as chlamydirosis, mycoplasmosis, and mycobacteriosis. Pharmacokinetics have been evaluated in several avian species. No commercially available liquid formulation but the drug can be compounded. Stable for 56 days at room temperature in corn syrup and water, cherry syrup and water, or a commercially available compounding syrup. Can also be dosed in the drinking water (less effective).
  - **Others** – Few pharmacokinetic or safety studies have been done for other fluoroquinolones in avian species. Marbofloxacin has longer elimination half-life, greater bioavailability, and tissue penetrating ability than enrofloxacin but has not been extensively studied in birds. 2.0 to 2.5 mg/kg PO q24hr was considered effective for most Gram-negative bacterial infections in Muscovy ducks. Orbifloxacin has a similar antibiotic spectrum to enrofloxacin and marbofloxacin. It has excellent oral bioavailability and tissue penetration in Japanese quail. Ciprofloxacin is an active metabolite of enrofloxacin in some avian species and can be used, but studies have not been conducted in companion avian species.

- **Tetracyclines** – Bacteriostatic, time-dependent antimicrobial efficacy.
  - **Doxycycline** – Semi-synthetic tetracycline, highly lipid soluble. First line of choice for the treatment of avian chlamydirosis. Treatment duration for avian chlamydirosis is 30 days for budgerigars and 45 days for other psittacine species. Refer to the most recent edition of the “Compendium of Measures to Control Chlamydiaphila psittaci Infection among Humans (Psittacosis) and Pet Birds (Avian Chlamydiosis)” for more information on treatment options for avian chlamydirosis. 400 mg/L in the drinking water was effective for the treatment of oral spiral bacteria in cockatiels.
  - **Others** – Other tetracycline drugs are less commonly used in birds. Chlortetracycline-medicated feed historically has been used to treat avian chlamydirosis. Oxytetracycline is available in a long-acting injectable formulation (Liquamycin LA-200, Zoetis, Kalamazoo, MI, USA) but can cause injection site tissue necrosis.

- **Macrolides** – Bacteriostatic. Time-dependent antimicrobial efficacy. Most effective against Gram-positive and anaerobic bacteria.
  - **Azithromycin** – Broad spectrum against Gram-positive and Gram-negative bacteria. Also effective against spirochetes and some anaerobes. Effective against Chlamydia psittaci in cockatiels at 40 mg/kg PO q48hr x 21 days.
  - **Others** – Pharmacokinetic and safety information are lacking for other macrolides such as erythromycin and lincomycin, and so they are less frequently used and recommended in companion birds. Erythromycin is marketed for use in sick birds and was available over-the-counter (Ormacyn-Plus, Mardel Laboratories, Glendale Heights, IL, USA) but may no longer be available. Tylosin powder (Tylan, Elanco Animal Health, Indianapolis, IN, USA) is available over-the-counter for the treatment of respiratory illness in chickens.

- **Lincosamides** – Bacteriostatic. Most effective against Gram-positive and anaerobic bacteria.
  - **Clindamycin** – The most commonly used lincosamide in birds. Effective against Gram-positive cocci and obligate anaerobes. No studies have been done in psittacine species but the drug has been investigated in pigeons and a suggested dosage was 100 mg/kg PO q6hr in pigeons.
• **Potentiated sulfa drugs** – The combination is probably bacteriostatic at dosages used in birds but can be bactericidal at higher dosages. Time-dependent efficacy. Broad spectrum of activity, effective against Gram-positive and Gram-negative bacteria and some anaerobes and parasites.
  - Trimethoprim-sulfamethoxazole – Popular for use in companion birds, particularly pediatric patients. Available in a liquid form but high volumes often required. Pharmacokinetic studies have not been done in psittacine birds.

• **Penicillins** – Bactericidal. Time-dependent antimicrobials. Effective against many Gram-positive bacteria but Gram-negative resistance is common. Extended-spectrum and combination drugs often used in avian medicine to enhance Gram-negative spectrum. Major disadvantages are cost and frequency of administration, as the elimination half-life is usually very short.
  - Amoxicillin-clavulanic acid – Achieved therapeutic plasma concentrations in Amazon parrots when dosed at 125 mg/kg PO q8hr
  - Piperacillin – Demonstrates excellent activity against some Gram-negative bacteria. Often combined with tazobactam (eg. ZOSYN, Pfizer, Philadelphia, PA, USA).

• **Cephalosporins** – Bactericidal, time-dependent efficacy. First-generation drugs have good Gram-positive spectrum, third-generation drugs have excellent Gram-negative spectrum. Like the penicillins, most cephalosporins are rapidly eliminated, requiring frequent dosing of at least three times daily. Extra-label use banned in major food-producing animals including chickens and turkeys as of 2012.
  - Cephalexin – First generation cephalosporin. Good Gram-positive spectrum, useful for treating infections with sensitive strains of *Staphylococcus aureus*.
  - Cefovecin sodium (eg. Convenia, Zoetis, Kalamazoo, MI, USA) – Third generation cephalosporin. Highly protein bound in dogs and cats, which results in long elimination half-life. Elimination half-life in chickens was very short (0.9 hours vs. 5.5 days in dogs). Similar findings in African grey parrots and red kites. Half-life in greys at 20 mg/kg IM was 64 minutes. Cannot be recommended in birds at this time.
  - Ceftiofur crystalline-free acid (eg. Excede, Zoetis, Kalamazoo, MI, USA) – Third generation cephalosporin. Bactericidal. Broad-spectrum. Oil base allows extended release. In helmeted guineafowl, plasma concentrations remained above MIC for many bacterial pathogens for at least 56 hours in all birds, and a dosage of 10 mg/kg IM q72 hours was suggested for this species. In red-tailed hawks, plasma concentrations were maintained above targeted ranges for 36 to 45 hours at 10 mg/kg IM and for 96 to 120 hours at 20 mg/kg IM. In black ducks, plasma concentrations were maintained above target for 73.3 hours at 10 mg/kg IM.

• **Aminoglycosides** – Bactericidal, concentration-dependent efficacy. Generally have excellent Gram-negative efficacy, not effective against anaerobes. Not absorbed from the GI tract and must be injected. Disadvantages include increased risk of toxicity such as nephrotoxicity. Gentamicin and amikacin are the most commonly used aminoglycosides in companion birds.

**Selected antifungal agents**

• **Azoles** – Inhibit synthesis of ergosterol in fungal cell membranes by inhibiting fungal cytochrome P450 isoenzyme.
  - Itraconazole – Probably the most commonly used antifungal in companion birds, particularly for the treatment of aspergillosis. Hepatic conversion into a number of active metabolites. Pharmacokinetics have been done in different avian species, species-specific variability evident. Use only the commercially available liquid or capsules, extemporaneous compounding not advised.
  - Fluconazole – Has very good activity against *Candida* spp., *Cryptococcus* spp., *Blastomyces* spp. Poor *in vitro* activity against most filamentous fungi. Well absorbed from the GI tract. Very water soluble. Minimally metabolized, excreted unchanged by the kidneys.
  - Voriconazole – Newer generation antifungal agent. Good *in vitro* and *in vivo* activities against yeast and filamentous and dimorphic fungi including *Candida* spp., *Cryptococcus neoforms*, and *Aspergillus* spp. Little to no efficacy against zygomycetes. Nonlinear pharmacokinetics with saturable hepatic metabolism, indicating that species-specific studies are needed.
  - Others – Use of ketoconazole and enilconazole is occasionally reported in the literature in companion avian species and raptors, but pharmacokinetic and safety data are lacking.

• **Terbinafine** – Blocks ergosterol synthesis by interfering with squalene monoxygenase and is believed to be fungicidal. Not mediated through cytochrome P450. *In vitro* activity against *Microsporum* spp., *Trichophyton* spp.,
Candida spp., Aspergillus spp., Blastomyces spp., and Histoplasma spp. Used primarily for dermatophytosis in veterinary medicine, but is also used in the treatment of aspergillosis. Can be administered orally or nebulized.

- **Amphotericin B** – Polyene macrolide antifungal agent, most often used for the treatment of disseminated aspergillosis and candidiasis. Currently the only fungicidal drug used in veterinary medicine effective against systemic infections. Poor GI absorption. The major risk is the potential for nephrotoxicity. Most frequently used as an injectable systemic treatment for aspergillosis in companion birds. Also administered orally for the treatment of macrorhabdosis (infection with the proventricular ascomycetous yeast Macrorhabdus ornithogaster).

- **Nystatin** – Polyene antifungal agent. Popular treatment for gastrointestinal yeast infections in birds, particularly in pediatric patients. Minimally absorbed from the GI tract.

### Selected antiparasitic agents

- **Avermectins** – Macrocyclic lactone derivatives with potent anthelmintic activity. Few pharmacokinetic and safety studies have been conducted in companion avian species. Ivermectin is popular for the treatment of air sac mites in finches and canaries and for the treatment of Knemidocoptes (scaly face, scaly leg) mite infestations. It is generally dosed orally. Spot-on application to the featherless tract over the jugular vein is popular but carries a significant risk of inaccurate and excessive dosing. The topical avermectin selamectin has reportedly been used for the treatment of knemidocoptic infections in budgerigars and for the treatment of air sac mites in zebra finches. Moxidectin (SCATT, Vetafarm, Wagga Wagga, NSW, Australia) is not currently available as a FDA-approved drug in the United States but is popular for use as a topical treatment for mite infestations. Pharmacokinetics of topical selamectin have been investigated in helmeted guineafowl and the drug appeared to maintain effective plasma concentrations for 19 days and no adverse effects were seen.

- **Benzimidazoles** – Broad class of highly effective anthelmintics and widely popular in avian medicine for the treatment of enteric parasitic infections such as infections with ascarids and Capillaria spp. The most popular benzimidazole agents used in companion avian medicine are fenbendazole and albendazole. Fenbendazole is also conveniently available in commercially available liquid formulations. Radiomimetic dosage-dependent bone marrow suppression has been reported with the use of benzimidazoles in avian species including pigeons, doves, and cockatiels.

- **Nitroimidazoles** – This class of drugs demonstrates both antiprotozoal and antibacterial activity. Metronidazole is frequently used for the treatment of anaerobic infections in companion birds. Carnidazole and ronidazole are not available as FDA-approved drugs in the United States, but carnidazole is widely used internationally for the treatment of trichomoniasis in racing and show pigeons. The use of nitroimidazole drugs such as metronidazole is prohibited in food-producing animals including poultry such as backyard chickens.

### Suggested reading


Atherosclerosis is a devastating disease common in older birds and often associated with sudden clinical decline and unexpected death. Other than humans, birds appear more susceptible to atherosclerosis than any other mammalian species. The reported incidence rates in avian species range widely from 1.9 to 91.9%.

**Risk factors**

Suggested risk factors for atherosclerosis in birds include age, gender, species, increased plasma concentrations of lipids and lipoproteins, high energy diets, physical inactivity, genetics, and coinfection with *Chlamydia psittaci*.

**Age**

Increased age has been shown to be a significant risk factor for the development of atherosclerosis in parrots in retrospective studies.

**Gender**

Female gender was shown to be a statistically significant risk factor in a recent multi-center case review. Estrogens are associated with increased plasma concentrations of cholesterol, triglycerides, lipoproteins, and calcium for the production of eggs. Reproductive diseases were found to be significantly linked to an increased rate of atherosclerosis in female parrots.

**Species**

African grey parrots (*Psittacus erithacus*), Amazon parrots (*Amazona* spp.), Quaker (monk) parakeets (*Myiopsitta monachus*), and cockatiels (*Nymphicus hollandicus*) appear especially susceptible to the disease. Cockatoos (*Cacatua* spp.) and macaws (*Ara* spp.) seem to be somewhat resistant to disease. Explanations for the variability in species susceptibility are speculative at best, but the disease may be associated with differences between captive and wild lifestyles, stress factors, dietary requirements, or genetics.

**Plasma lipids and lipoproteins**

African grey parrots and Amazon parrots tend to have higher plasma concentrations of cholesterol compared with other psittacine species. In one study, parrots with atherosclerotic lesions had a significantly higher median plasma cholesterol concentration than control birds. Experimentally induced atherosclerosis caused by adding cholesterol to the diet was associated with increases in plasma cholesterol concentrations in Quaker parakeets and budgerigars (*Melopsittacus undulatus*) and increased low-density lipoproteins (LDL) in Quaker parakeets. In Quaker parrots, plasma cholesterol concentrations were correlated with the severity of the atherosclerotic lesions.

**Coinfection with *Chlamydia psittaci***

The association between infection with *Chlamydia pneumoniae* infection and atherosclerosis has been investigated in humans but remains a controversial topic. Research in birds has yielded conflicting results and evidence for a correlation is lacking. Research in birds using PCR for *C. psittaci* did not find a positive association between the two diseases but a case-control study using immunohistochemistry and specific anti-*C. psittaci* monoclonal antibodies did. However, anti-chlamydial antibodies are known to cross-react with ceroids and other atherosclerotic plaque lesions in humans, and this may have affected the results in this study.

**Pathologic lesions**

Atherosclerotic lesions consist of accumulations of fats, cholesterol, cellular debris, and inflammatory cells within the vascular media and intima. Lesions are classified into 7 categories depending upon histologic findings and severity. Type 4 lesions (atheroma) contain a lipid core; type 5 lesions (fibroatheroma) are covered by a fibrous cap; complications are present with type 6 lesions, such as thrombosis, fissures, and hematomas. Complications and clinical signs usually result from stenosis or plaque disruption leading to thrombosis or hemorrhage. Stenosis is common in birds, while atherothrombosis and thromboembolic disease appear rare or may be underdiagnosed.

Most lesions are found in the great vessels at the base of the heart, including the brachiocephalic arteries, ascending aorta, and pulmonary arteries. Lesions in the descending aorta and peripheral vessels are less common. However, lesions in the carotid and coronary arteries have been reported in parrots. Atherosclerosis can be associated with lesions in other organ systems, such as myocardial hypertrophy and fibrosis, and pulmonary congestion and fibrosis.

**Clinical signs**

The most common clinical finding with atherosclerosis is unexpected death. When clinical signs are seen, they are often associated with stenosis of the major vessels or carotid arteries. Clinical signs often are seen in the cardiovascular, neurologic, and pulmonary systems such as congestive heart failure, dyspnea, exercise intolerance, ataxia, lethargy, behavior changes, stroke, and intermittent claudication (eg. pelvic limb ataxia).
Diagnosis

Bloodwork

The diagnosis of atherosclerosis in the living bird is challenging at best. Although dyslipidemia and hypercholesterolemia are associated with disease in parrots, elevated plasma concentrations of cholesterol, triglycerides, and lipoproteins are not necessarily diagnostic for the disease. For example, there are wide fluctuations in plasma concentrations of these substances throughout the reproductive cycle of the normal healthy female parrot.

Noninvasive indirect blood pressure (NIBP)

Measurement of the noninvasive indirect blood pressure (NIBP) can help detect chronic hypertension associated with atherosclerosis. However, current methods for the measurement of NIBP in parrots such as Doppler probe techniques and oscillometry are considered unreliable. At best, NIBP in parrots may be useful for identifying extreme (very low or very high) values and trends over time and in response to therapeutic measures.

Imaging

If severe calcification of the great vessels is present, this may be seen on plain survey radiographs. The two brachiocephalic arteries, pulmonary arteries, and ascending aorta can be visualized on plain films and also by computed tomography (CT). However, because of factors such as heart and patient movement and because of the fact that many cases of atherosclerosis in birds are not associated with blood vessel mineralization, plain radiography should be considered an insensitive diagnostic tool. Selective angiography and associated tools such as fluoroscopy and CT are better able to detect stenotic changes in blood flow associated with atherosclerosis in birds. Ultrasonography, particularly using the transesophageal method, may be useful for imaging of the aortic root and to detect changes in aortic outflow velocity. Hyperechoic changes to the aortic wall can be detected. Elevations in the pressure gradient across the right atrioventricular valve seen by ultrasound imaging can be suggestive of pulmonary hypertension. Cerebral complications such as ischemia or hemorrhagic stroke can be detected with CT or magnetic resonance imaging (MRI).

Medical management

Clinical management of arteriosclerosis in birds is currently empirical at best. Treatment should be aimed at addressing underlying causes and contributing factors (if known) as well as managing complications such as systemic hypertension or congestive heart failure. Statins are anecdotally used in birds but remain controversial as few to no pharmacokinetic studies have been done for this group of drugs and target plasma concentrations of cholesterol and LDL are not yet known for birds. Rosuvastatin administered at 10 to 25 mg/kg PO failed to achieve consistent target plasma concentrations in Hispaniolan Amazon parrots (*Amazona ventralis*) in one unpublished study. Other treatments with reported use in birds include pentoxifylline or isoxsuprine for the anecodal management of peripheral arterial disease in Amazon parrots. Antihypertensive agents such as angiotensin-converting enzyme (ACE) inhibitors and beta-blockers may help relieve clinical signs of hypertension, although their effectiveness for this purpose have not been studied in avian patients. Antithrombotic agents are not commonly used in parrots as atherothrombosis appears to be rare.

Prevention

Because atherosclerosis in birds is still poorly understood, it is not clear yet what preventative measures are effective. However, by evaluating the risk factors for human and avian disease, several options seem possible to reduce the likelihood of developing the disease. Birds should be provided ample opportunities for exercise and activities such as foraging, and even flight, if considered safe for the bird. Excessive energy content in the food should be avoided, such as excess carbohydrates and fats. Bird should receive regular preventative veterinary care with periodic bloodwork monitoring.

Suggested reading


Pain recognition
As avian practitioners, it is our ethical obligation to reduce and treat pain and stress in our avian patients. Birds are quite capable of responding to painful stimuli (nociception). Nociception is the result of transduction, transmission, and modulation of stimuli in response to thermal, mechanical, or chemical tissue insult. Birds possess high-threshold mechanothermal, mechanochemical, mechanical, and thermal peripheral nociceptors. The distribution of neurons in the nociceptive spinothalamic tract is similar in birds and mammals. But more than that, birds are also capable of experience pain, which is the conscious and emotional response to noxious stimuli. Pain can be very challenging to identify in the avian patient, even in the companion bird, and for this reason pain is often under-recognized and inadequately treated in birds. As prey species, birds are adept at hiding pain. In the stressful hospital setting, birds are even more likely to hide signs of pain. Normal behaviors are altered when birds are painful. Some signs of pain in avian patients described by owners or observed in the hospital setting include:

- Changes in social interactions
  - Decreased interactions with conspecifics or human companions
  - Decreased grooming of conspecifics
  - Isolation from conspecifics
  - Decreased vocalizations

- Guarding behavior
  - Changes in posture (shifted perching position, limp, wing droop, etc.)

- Aggression towards conspecifics or human companions

- Changes in grooming behavior
  - Decreased self-grooming
  - Feather destructive behavior
  - Self-mutilation

- General “Sick Bird Signs”
  - Decreased food and water intake
  - Decreased activity
  - Fluffed, ruffled appearance

Treatment of pain
Treatment of pain should be directed at resolving the source of tissue injury or disease, in addition to the use of analgesic drugs and other treatments. Signs of pain may be identified before a diagnosis is made, warranting analgesic therapy in advance of or during the collection of diagnostic information.

Regional anesthesia and analgesia
Lidocaine and bupivacaine block axonal sodium channels, interfering with action potential conduction. Regional infiltration through line blocks and splash blocks is the most common method for administering local anesthesia and analgesia to birds. Birds are possibly more sensitive to the adverse effects of local anesthetics, so dosages administered should not exceed the suggested dosages.

- Lidocaine 2% (20 mg/ml)
  - Suggested dosage – 2 to 3 mg/kg

- Bupivacaine 0.25 to 0.50% (2.5 to 5.0 mg/ml)
  - Suggested dosage – 1 to 2 mg/kg
  - Comments
    - Variable effectiveness in mallard ducks (*Anas platyrhynchos*) for brachial plexus block.

Opioids
Opioids are most often used for moderate to severe pain, such as traumatic or surgical pain. Most opioids are rapidly absorbed and eliminated in birds. Most opioids also have poor oral bioavailability in birds, associated with a first-pass effect in the liver, making oral administration generally ineffective.
Avian opioid receptors

Opioids are categorized as agonists, partial agonists, mixed agonists/antagonists, or antagonists based on their ability to produce an analgesic response at a specific opioid receptor. Regional distribution of mu, kappa, and delta opioid receptors in the forebrain and midbrain in birds are similar to mammals. However, kappa and delta receptors are more prominent in the forebrain of pigeons (Columba livia), and 76% of receptors were kappa in one study. Results from studies in chickens (Gallus gallus domesticus) suggest that birds may not possess distinct mu and kappa receptors, or perhaps the receptors have similar functions. The analgesic effects of different opioid receptors in birds still have yet to be fully elucidated.

Opioid drugs

- **Morphine** - Pure mu-agonist
  - Suggested dosage – None at this time
  - Comments
    - Not commonly used in birds. Conflicting or questionable effects in birds

- **Hydromorphone** - Primarily a mu-agonist
  - Suggested dosage – None at this time
  - Comments
    - At 0.60 mg/kg IM, response seen for up to 3 hours in American kestrels (Falco sparverius)

- **Fentanyl** - Short-acting mu-agonist
  - Suggested dosage – None at this time
  - Comments
    - No effect on thermal withdrawal threshold in cockatoos (Cacatua alba) at 0.02 mg/kg but analgesic response seen at 0.20 mg/kg. Hyperactivity seen in some birds.
    - Intravenous CRI at targeted plasma concentrations of 8, 16, and 32 ng/ml in red-tailed hawks (Buteo jamaicensis) and in Hispaniolan Amazon parrots (Amazona ventralis) was isoflurane-sparing (reduced MAC by 50% in Amazon parrots), suggesting analgesic effect

- **Butorphanol** - Kappa agonist, weak mu antagonist. Mixed agonist/antagonist
  - Suggested dosage
    - 1 to 4 mg/kg IM q 1 to 3 hours
    - 20 to 50 mcg/kg/min IV CRI (with 3 mg/kg loading dosage)
  - Comments
    - Most commonly used opioid in birds
    - May not have thermal antinociceptive effect in kestrels at 1, 3, and 6 mg/kg IM
    - Experimental long-acting liposomal-encapsulated butorphanol may extend duration of action (not yet commercially available)
    - Oral bioavailability poor (<10% in Hispaniolan Amazon parrots)

- **Buprenorphine** - Partial mu agonist, kappa activity less well defined. Mixed agonist/antagonist
  - Suggested dosage – None at this time
  - Comments
    - Increased withdrawal latencies from noxious electrical stimulus in pigeons at 0.25 and 0.50 mg/kg for 2 and 5 hours, respectively.
    - No analgesic effect in red-tailed hawks with orthopedic injuries at 0.25 mg/kg
    - In African grey parrots (Psittacus erithacus), 0.10 mg/kg IM maintained plasma concentrations in the human analgesic range for 2 hours and increased withdrawal latencies to electrical stimulus

- **Nalbuphine hydrochloride** - kappa agonist, partial mu antagonist (similar to butorphanol)
  - Suggested dosage – 12.5 mg/kg IM q 3 hours
  - Comments
    - Causes little to no sedation, no adverse effects
    - Only available in injectable form (Nubain, 10 mg/ml, 20 mg/ml)
    - Not a controlled substance under the DEA CSA (Controlled Substance Act)
    - Nalbuphene decanoate at 33.7 mg/kg in Amazon parrots increased thermal withdrawal threshold values for up to 12 hours (not commercially available).

- **Tramadol**
  - Opioid receptor effect –mu agonist, weak kappa and delta activity
- M1 metabolite much more potent agonist, present in birds studied to date
- Active at opiate, alpha-adrenergic, and serotoninergic receptors
  - Suggested dosage
    - 15 mg/kg PO q 12 hours
    - 30 mg/kg PO q 6 hours (Hispaniolan Amazon parrots, PD study)
  - Comments
    - Minimal evidence of efficacy in birds and other species
    - Wide species variability

**Gabapentin (Neurontin)**
- GABA analog, mode of action not completely understood, used to treat neuropathic pain in humans. Anecdotal evidence suggests it may be of benefit in treating self-mutilation in birds.
- Suggested dosage – 10 to 80 mg/kg PO
- Comments
  - Half-life at 10 mg/kg PO to Amazon parrots was 4.5 hours in one recent study.
  - The commercially available oral suspension of gabapentin contains xylitol and should not be used in birds. Gabapentin should be extemporaneously compounded for each patient.

**Nonsteroidal anti-inflammatory drugs**
Used to relieve musculoskeletal and visceral pain. Effective for both acute and chronic pain. The anti-inflammatory and analgesic effects last longer than the predicted half-life, possibly due in part to strong protein binding properties.

- **Ketoprofen** - Potent non-selective COX-1 inhibitor
  - Suggested dosage – 2 to 5 mg/kg IM
  - Comments
    - Very low oral bioavailability in Japanese quail (*Coturnix japonica*)
- **Carprofen** - Weak inhibition of COX-1 and COX-2
  - Suggested dosage – 1 to 4 mg/kg PO, SQ, or IM q 12 to 24 hours for less than 7 days
- **Meloxicam** - Selective COX-2 inhibitor
  - Suggested dosage – 0.50 to 2.0 mg/kg PO q12 to 24 hours
  - Comments
    - Available in liquid form at 1.5 mg/ml and 0.50 mg/ml. Injectable 5 mg/ml
- **Celecoxib** - Selective COX-2 inhibitor
  - Suggested dosage (PDD) – 10 to 20 mg/kg PO q 24 hours for 6 to 12 weeks

**Adjunctive therapies**
Other therapeutic modalities have been used for analgesia with varying degrees of success, such as acupuncture, thermotherapy (cryotherapy), low level (cold) laser therapy, and therapeutic ultrasound.

**Balanced (multi-modal) and preemptive analgesia**
Balanced, or multi-modal, analgesia refers to the combination of analgesic drugs that act through different modalities. The combination of two or more analgesics can produce a synergistic response. Balanced analgesic can allow reduction of the cumulative dosages of individual drugs, reducing the likelihood of an adverse effect. Surgical incisions and other painful procedures may induce prolonged changes in the CNS that might contribute to or prolong postoperative pain. Therefore, preemptive analgesia, or administration of analgesics prior to a procedure that causes tissue injury, may have significant beneficial effects.

**Suggested reading**


The vast majority of companion birds have not been surgically or chemically altered and are fully capable of experiencing natural hormonal influences on the reproductive tract and the body as a whole. These hormonal influences are often inadvertently stimulated by interactions with well-intended human companions and frequently lead to undesirable behaviors and serious health concerns. Egg laying and reproduction are generally considered undesired activities for the companion bird. Clinicians must be able to recognize factors that contribute to reproductive diseases in birds such as gender, diet, housing, photoperiod, and human interactions and instruct clients on proper diet and husbandry in order to help prevent reproductive behavior and medical problems from occurring.

Selected female reproductive disorders

Chronic egg-laying

For the typical companion female bird, it is best if the bird lays no eggs at all. Egg laying is considered excessive when frequent clutches or clutches with an abnormally large number of eggs are laid. Repetitive egg laying can exhaust the oviduct and calcium stores, predisposing to oviductal inertia, egg binding, abnormal egg development, and other secondary problems such as opportunistic bacterial salpingitis and yolk peritonitis. Chronic egg laying is most commonly seen in smaller species such as cockatiels (Nymphicus hollandicus), budgerigars (Melopsittacus undulatus), lovebirds (Agapornis spp.), canaries (Serinus canaria domestica), and finches. Predisposing factors include an abundance of energy-rich foods, prolonged photoperiod, readily available perceived nesting sites and substrates, excessive physical and vocal stimulation from other birds or human companions, and genetic factors.

Management and prevention include an energy-moderate or energy-restricted diet, shortening of the photoperiod, removing perceived nesting sites and substrates, limiting physical interactions, and encouraging other activities such as foraging, target training, and play. If these environmental and behavioral modifications are ineffective, medical intervention can be considered if the bird is considered at risk of or has developed medical complications. Pharmacologic options include medroxyprogesterone acetate, human chorionic gonadotropin, leuprolide acetate, and deslorelin acetate, among others. All pharmacologic options have significant limitations, risks, and disadvantages. For example, leuprolide acetate (e.g., Lupron Depot 3.75-mg 1-month, AbbVie, North Chicago, IL, USA) is very expensive, variably effective, and is very short-acting, lasting only about 2 to 3 weeks in cockatiels. Deslorelin acetate 4.7-mg implants available in the United States for use in domestic ferrets (Mustela putorius furo) for the treatment of adenocortical disease (Suprelorin F, Virbac Animal Health, Fort Worth, TX, USA) have demonstrated variable effectiveness and short duration of action in avian species for the treatment of reproductive disease. The implants are not approved by the FDA but are legally marketed as an FDA index drug, and extra-label use (e.g., in birds) is prohibited. Salpingohysterectomy can be considered, but the significant risks and expense of surgery generally do not outweigh the benefits for surgery in cases of uncomplicated chronic egg laying in otherwise healthy birds.

Egg binding and dystocia

A bird is considered egg bound if it has not produced an egg known to be present for longer than the normal period of development. Dystocia is defined by mechanical obstruction to oviposition. Most companion psittacine birds lay eggs at variable intervals greater than 24 hours, and so it can be difficult to determine with certainty if a bird has egg binding or dystocia unless the bird has been repeatedly straining for more than a few hours or if there is blood in the droppings, prolapse of cloacal or oviductal tissues, lameness, or signs of generalized illness. Factors such as chronic egg laying, nutritional deficiency, obesity, malformed eggs, primary oviductal disease, and genetics can result in egg binding and dystocia. Oviductal torsions and rupture have been reported in companion birds. As with chronic egg laying, smaller bird species are more commonly affected by egg binding and dystocia.

An egg is usually, but not always, palpable in the caudal belly when a bird is egg bound. Eggs can be present higher in the coelom where they cannot be palpated, or can be collapsed and not detectable by palpation. Survey radiography and ultrasonography can be very useful in further evaluating a bird for egg binding and dystocia. Bloodwork is helpful to evaluate the bird for complications and evidence of systemic disease. Supportive care should be provided, such as fluid and nutritional therapy. Analgesia should be provided if indicated. Broad spectrum antimicrobial therapy should be considered if the oviduct is believed compromised or peritonitis is present or suspected. Pharmacologic agents can be considered to facilitate oviposition, such as dinoprostone, a prostaglandin E2 (e.g., Prepidil 0.5mg/3g endocervical gel, Pfizer, NY, NY, USA); dinoprost tromethamine, a PGF2α (e.g., Lutalyse Sterile Solution, Zoetis, Kalamazoo, MI, USA); and oxytocin. Great caution is advised to prevent skin exposure in women with the use of PGE2 drugs due to the risk of altered menses or spontaneous abortion. Unlike PGE2, PGF2α and oxytocin do not cause relaxation of the uterovaginal sphincter while inducing oviductal contractions, which may result in oviductal tears. If supportive measures and medical intervention fail to induce oviposition, manual manipulation and delivery of the egg can be attempted if the egg is present within the oviductal lumen. Anesthesia is general advised except in the most critical patients. Analgesia is strongly recommended. If the egg cannot be manually delivered, it can be imploded to relieve the immediate pressure, and attempts can then be made to extract the collapsed shell.
If the egg cannot be detected within the lumen of the oviduct, it may have entered the intestinal peritoneal cavity by retropulsion through the oviductal infundibulum or through an oviductal tear. Exploratory surgery is necessary in these cases to retrieve the egg material, in which case salpingohysterectomy should also be considered.

**Oviductal prolapse**

Prolapse of oviductal tissues can occur as a complication to chronic egg laying, oviductal inertia, egg binding and dystocia, and space-occupying masses. Prolapses often occur secondary to excessive or prolonged straining from undesired behaviors such as self-stimulation and from medical causes. Treatment is aimed at stabilizing the patient with fluid therapy and nutritional support and analgesia. The prolapsed tissues must be protected against dessication and necrosis. The tissues can be gently cleaned with a disinfecting solution such as diluted chlorhexidine gluconate. The tissues should be gently replaced as soon as possible. If the tissues cannot be immediately replaced, they should be kept lubricated such as with a sterile methylcellulose gel. Transfixing sutures across the vent opening may be necessary to keep the tissues in place after reduction. Ensure that the bird can still defecate normally between the sutures. Bloodwork and survey radiographs should be considered to evaluate the bird for underlying and predisposing diseases and for complications. Sterile swabs of the prolapsed tissues can be submitted for microbiologic culture. Broad spectrum antimicrobials should be administered based on results of culture and sensitivity testing. Recommendations useful for the management of chronic egg laying often apply to cases of oviductal prolapse. Nutritional deficiencies and other underlying health problems should be addressed. Salpingohysterectomy should be considered for severe or recurring cases.

**Yolk peritonitis**

When yolk is present free within the intestinal peritoneal cavity, it can cause a massive localized inflammatory reaction, resulting in accumulation of free fluid, blood, and inflammatory cells. Any disease that results in rupture of an ovarian follicle or rupture of a peritoneal egg containing yolk can result in yolk peritonitis. Predisposing causes include cystic ovarian disease, salpingitis, metritis, oviductal rupture, reproductive neoplasia and granulomatous diseases, and oviductal torsion. Bloodwork can be helpful to assess the bird for overall health. Many affected birds will have severe leukocytosis and heterophilia. Imaging through radiography and ultrasound can provide important additional diagnostic information, such as the presence of egg material or other space-occupying lesions. Peritoneal fluid aspiration from the ventral midline can provide diagnostic material for analysis, and can also help relieve pressure from fluid accumulation. Therapy often consists of analgesics, anti-inflammatories such as meloxicam, broad spectrum antibiotics, and other treatments aimed at suppressing reproductive activity previously described. If peritonitis is persistent or recurrent, additional diagnostics such as laparoscopy and surgical exploratory should be considered, as well as more aggressive treatment measures such as salpingohysterectomy.

**Cystic ovarian disease**

Ovarian cysts have been reported in a number of avian species including cockatiels, budgerigars, and canaries. Cysts can develop secondary to chronic endocrine disorders, anatomic ovarian malformation, and neoplasia. A genetic predisposition may be present in some birds. Chronic reproductive behavior without egg production, or a drop in reproductive performance may be observed. Advanced disease may be associated with signs of generalized illness or coelomic distension. Radiographs may demonstrate polyostotic hyperostosis and a generalized increase soft tissue opacity in the coelom consistent with fluid accumulation. Ultrasonography can be very useful in detecting free fluid and cysts on the ovary. Cysts can also easily be visualized by laparoscopy. Aspiration of cysts and partial oophorectomy can be considered in advanced cases. Pharmacologic therapy may be of benefit in certain cases.

**Oophoritis**

Ovarian inflammation can be caused by infectious agents or through neoplastic conditions or by extension of regionally located disease processes such as pancreatitis. Infectious oophoritis is often cause by hematogenous or localized spread of bacteria. Clinical signs are typically vague but often include signs of generalized illness, egg binding, cessation of egg production, and unexpected death. Survey radiographs and ultrasonography can be useful to detect fluid accumulation in the area of the ovary. Laparoscopy can be very useful for visualizing the ovary and for collecting diagnostic samples for culture and cytology. Treatment includes bactericidal antibiotics based on results of culture and sensitivity testing. Pharmacologic agents such as leuprolide acetate can be helpful in temporarily shutting down ovarian activity. A partial oophorectomy can be considered for advanced or recurrent cases.

**Reproductive neoplasia**

Ovarian and oviductal neoplasia are common in companion birds, particularly in budgerigars. Clinical signs include weight loss, lethargy, inappetence, coelomic distension, left leg lameness, and dyspnea. Reproductive complications can be seen with neoplastic diseases, such as egg binding and dystocia and oviductal prolapse. Reported neoplasms include ovarian and oviductal adenoma and adenocarcinoma, lymphoma, leiomyosarcoma, and ovarian granulosa cell tumors. Survey radiographs and ultrasonography can be very useful in the diagnosis of reproductive neoplasia. Definitive diagnosis requires cytology or histopathology of excised tissues. Treatment options include salpingohysterectomy or partial oophorectomy, depending upon the location of the neoplasm. For many neoplasms, such as oviductal adenocarcinoma, regional invasion and postoperative recurrence are common. Chemotherapeutic agents such as carboplatin can be considered, although no consistent results have been reported to date.
Selected male reproductive disorders

Orchitis

Testicular infections can occur through hematogenous or localized spread or through ascending infections. Most infections are bacterial. Clinical signs are often vague and include signs of generalized illness such as lethargy and inappetence. Leukocytosis with heterophilia may be present. Laparoscopy can be very useful for visualizing the testicles and for the collection of tissue aspirates for culture and cytology. Treatment is with bactericidal antibiotics based on results of culture and sensitivity testing. Orchidectomy is possible, either through a laparoscopic or surgical approach, but can be technically challenging and carries some risk.

Reproductive neoplasia

Testicular neoplasia is very common in male budgerigars and has also been reported in other companion avian species. Clinical signs include lethargy, reduced appetite, loss of body condition, coelomic distension, ascites, dyspnea, and unilateral pelvic limb paresis, paralysis, or cyanosis. Hyperestrogenemia from Sertoli cell tumors can result in a color change of the cere from the blue or purple color of a male bird to the pink color of a female bird. Diagnosis in small birds such as budgerigars can be challenging, but survey radiographs and ultrasonography can be useful. Treatment options are very limited but chemotherapy and orchidectomy can be considered.

Suggested reading

Raising backyard poultry can be rewarding not only for the production of consumable eggs and meat, but also for companionship and personal enjoyment. Providing veterinary care for these clients and their birds can be equally rewarding as long as the veterinarian is armed with a solid understanding of federal, state, and local laws and regulations that affect backyard poultry and with a working knowledge of common diseases and treatments for these species.

Definition of “poultry”
The term “poultry” should be considered as referring to any avian species that has the potential for its meat, eggs, or other parts (e.g. offal, feathers, manure) directly or indirectly entering the human food chain, regardless of the actual use of individual birds of each species. The Code of Federal Regulations (CFR) defines “major” animal species as dogs, cats, horse, cattle, swine, chickens, and turkeys. All others are considered “minor” animal species, such as ducks, geese, game birds, pigeons, etc.

Demographics
It is widely recognized that backyard poultry are growing in popularity. With a national trend towards locally produced foods and organic foods, this fact is not surprising. Raising poultry can also be personally enriching and educational. According to the United States Department of Agriculture (USDA) National Animal Health Monitoring System (NAHMS) Poultry 2010 survey “Urban Chicken Ownership in Four U.S. Cities,” which surveyed urban chicken ownership in Denver, Los Angeles, Miami, and New York City, 0.8% of all households in these cities owned chickens and 4.3% of single-family homes on one acre or more. Nearly 4% of households that did not have chickens at the time of the survey were planning on owning chickens within the next 5 years. With the recent steady decline in parrot ownership, poultry veterinary patients will undoubtedly become more common in the upcoming years.

Species
Most poultry species fall within a few avian orders, including Galliformes (e.g. chickens, turkeys, quail, pheasants, grouse, guinea fowl), Anseriformes (ducks, geese, swans), and Columbiformes (pigeons and doves). Ratites such as ostriches and emus should also be considered as poultry species. Storey’s Illustrated Guide to Poultry Breeds 2007 is an excellent resource for learning about different poultry breeds.

The domestic chicken, *Gallus domesticus*, is widely believed to be descended from the red jungle fowl from geographical areas such as southern China and Indonesia, although there may have been genetic crossing with other avian species such as the grey and Sri Lankan jungle fowl. Today there are hundreds of breeds of chickens around the world, categorized by class (geographical area (e.g. American) or, for bantams, by physical traits such as Single Comb), variety (based on physical characteristics such as color and comb type), and strain. Chickens are often classified as standard breeds (usually larger and more popular or commercially raised for eggs or meat such as barred rocks and Rhode Island reds), bantam breeds (smaller breeds such as silkies), and heritage breeds. Commercial breeds include broilers and layers. See the American Poultry Association Standards of Perfection (http://www.amerpoultryassn.com) for further information about chicken breeds.

Regulation and biosecurity
Ownership laws and regulations
Although the commercial poultry industry is tightly regulated by federal and state laws, backyard poultry are largely exempt. Regulation of backyard poultry flocks is typically limited to local ordinances, and some municipalities have no regulations at all. Local ordinances can regulate ownership by requiring permits or licenses, or by dictating care and husbandry such as defining limits on property size and available coop space per bird and through nuisance clauses for noise, odor, and cleanliness.

Biosecurity and quarantine
Remember that “an ounce of prevention is worth a pound of cure.” Biosecurity is the cheapest and most effective means for limiting or preventing the introduction and spread of infectious agents to and within a backyard flock. There are three major principles to biosecurity – management of access (e.g. the “closed” flock concept, isolation or confinement), animal health management (e.g. good record keeping, veterinary care), and operational management (e.g. cleaning and disinfection, pest control).

Backyard poultry inherently pose a risk to the commercial poultry industry for the spread of highly pathogenic diseases such as exotic Newcastle disease (END) and highly pathogenic avian influenza (HPAI). The backyard poultry veterinarian serves a crucial role in the early detection and notification (reporting) of potentially serious contagious diseases.
Care and husbandry
This section on backyard poultry care and housing will be limited to the domestic chicken for the purposes of this discussion.

Housing (coop and pen)
The backyard chicken coop can range from simple to highly elaborate, but the basic requirements are the same – the coop must be easy to clean, secure from predators, allow adequate space per bird, and allow adequate ventilation. The coop should protect the birds from weather extremes.

- **Space** – Adult chickens need a minimum space of about 2 to 3.5 ft² (0.19 to 0.33 m²) per bird. Chicks up to 2 weeks of age need at least 10 square inches, but by 4 to 8 weeks of age then need at least 1 ft² (0.09 m²) per bird.
- **Bedding and flooring** – The coop floor can consist of concrete, wire, wooden slats, or dirt. Pine shavings, straw, and well-drained soil are common beddings for chickens, although pine shavings are most often used for chicks. Some coops are mobile, allowing movement around a yard to cleaner areas with fresh forages.
- **Nest boxes** – Nest boxes should be provided for layers, at one nest box for every 4 to 5 hens. Boxes should measure at about 12” x 14” (30 x 36 cm) for most breeds with about 6” (15 cm) of bedding and should be raised off the floor. Egg production begins at about 16 to 24 weeks of age and peaks at 32 to 34 weeks for many layer breeds. Production may slow or stop during shorter daylight months.
- **Perches** – Each bird should have at least 9 to 10” (23 to 25 cm) of perching space with 14” (36 cm) between perches,
- **Temperature** – The adult chicken is most comfortable and efficient at egg production between 70 and 75°F (21 to 24°C). Adult chickens may die of heat stress at temperatures over 95°F (35°C). Chicks initially should be kept at 95°F (35°C) with weekly decreases of 5°F (3°C) until room temperature is achieved.
- **Security** – Measures that can be taken to protect chickens from predators in the pen and coop include burying wire 6” (15 cm) deep or with a 12” (30 cm) bend, by double wiring the pen and providing a wire or solid roof, and by ensuring that the walls of the coop are predator proof. Free ranged chickens are at greater risk of predation, but a fenced in yard can provide some protection.

Diet
Selecting a diet for the backyard chicken will depend upon the age, species, and use of the birds. Commercially formulated diets are widely available for all poultry species, including galliformes, anseriformes, columbiformes, and ratites, and for a variety of life stages. Diets should be based on formulated feeds and supplemented with additional foods for enrichment such as vegetables, forages, fruits, and scratch feeds. Oyster shell grit should be provided to layers. Free ranging allows birds to forage for foliage and insects and provides enrichment. Supplements should be limited, particularly in rapidly growing birds, to reduce the risks of angular limb growth deformities. Obesity is common in adult birds and is often attributed to excessive energy foods and reduced activity. Clean, fresh water should always be provided in easily accessible waterers.

- **Chicks** –
  - 0 to 6 weeks of age – Chick starter ration (18 to 20% protein). Chick starter rations should contain a coccidiostat.
  - 6 to 14 weeks of age – Chick grower ration (16 to 18% protein)
  - 14 to 20 weeks of age – Developer ration (14 to 16% protein)
  - 20 to 24 weeks of age – Layer ration (16 to 18% protein)

Veterinary care
Although most standards of avian veterinary care apply to backyard poultry, the practitioner must also be aware of certain legal issues such as federal laws regulating drug use in food-producing species. Additionally, some veterinary duties may require Category II USDA accreditation. Professional organizations such as the USDA and state departments of agriculture, university poultry extension offices, and board-certified poultry or companion avian veterinarians are readily available for consultation and referral and often publish or otherwise provide free literature and other resources.

Anamnesis
Solid history taking and physical examination skills are very important in working with backyard poultry presented for veterinary care. The practitioner should always be aware of the client’s goals, expectations, and limitations to care. In addition to the standard anamnesis, information regarding the source of the bird, duration of ownership, vaccination status (eg. Marek’s disease), exposure to other birds, exposure to wildlife and feral birds, use of the bird (eg. companion, layer, meat producer), and use of the eggs and meat (if applicable) should be obtained.

Physical examination
The physical examination is straightforward. Chickens are generally very easy to examine but they do stress quickly and can become overheated. Some birds are calmer when the head is covered. A digital cloacal (“rectal”) exam is a useful method to help assess the gastrointestinal and reproductive tracts. The color of the comb and wattles can suggest anemia or cyanosis.
Diagnostics
Diagnostics routinely run for backyard poultry include fecal exams (both wet mount and flotation, occasionally sedimentation), bloodwork (hematology and biochemistry), and survey radiographs. Birds can be screened for infectious diseases if indicated, but clients should be advised in advance if any of these diseases is reportable. Necropsies are commonly performed to assess flock health for both commercial and backyard settings. Most states offer necropsy services to veterinarians and clients through state run veterinary diagnostic laboratories.

Drug regulations
Drug use in food producing animal species is heavily regulated by federal law, regardless of the use of individual animals. There are very few drugs that are labeled for use in poultry. The Animal Medicinal Drug Use Clarification Act (AMDUCA) of 1994 made extra label drug use (ELDU) legal in veterinary medicine with a valid veterinarian-client-patient relationship (VCPR). ELDU is allowed only for FDA approved drugs in food producing animals, and is not permitted for eggs or meat intended to be sold or given away. ELDU in feed is strictly prohibited. There are very specific requirements for record keeping and prescription labeling for ELDU in food producing animals. For example, medical records must be kept for at least 2 years. Withdrawal times for meat and eggs must be documented in the medical records and placed on the prescription label.

Restricted and prohibited drugs
Veterinarians treating backyard poultry must be aware of federally restricted and prohibited drugs. For example, fluoroquinolone antibiotics such as enrofloxacin and nitroimidazole antibiotics such as metronidazole are prohibited from use in food producing animal species such as poultry. A list of restricted and prohibited drugs is available on the Food Animal Residue Avoidance Databank (FARAD) website – (www.farad.org). If a withdrawal time for meat or eggs is not known for a particular drug, FARAD should be contacted. Expect a 1 to 3 day turnaround time for the information. Communication with FARAD and the provided withdrawal times, if known, must be documented in the medical record.

Some approved drugs in poultry
While there are a few drugs that are approved for use in poultry, their use may be restricted by the age or intended use of the bird. For example, the antibiotics tylosin and sulfadimethoxine are approved for use in broilers and replacement chickens. The dewormer piperazine is approved for use in broilers and replacement chickens, and amprolium is approved for use in all chickens. Regardless of the information here or in published formularies, always request information from FARAD to ensure the current approval status of any drug intended for use in food producing animal species such as poultry.

Suggested reading
Greenacre CB. Backyard poultry: A crash course so you are prepared. Proc Assoc Avian Vet 2013:3–12.
Diseases of Backyard Poultry
Lauren Powers, DVM, DABVP
Carolina Veterinary Specialists
Huntersville, NC

Infectious diseases
As stated in the accompanying lecture, “Introduction to Backyard Poultry,” biosecurity is an essential part of any poultry health management program. Steps to prevent exposure to infectious agents should be taken for every backyard flock, including minimizing visitor contact, maintaining a “closed” flock or quarantining new birds for at least two to four weeks, isolating sick birds, and providing periodic preventative veterinary services. Many poultry diseases are zoonotic, such as salmonellosis and campylobacteriosis. Many zoonotic and other diseases are reportable to state regulatory agencies. The poultry practitioner must be keenly aware of the public health concerns and concerns to the commercial poultry industry with regards to zoonotic and reportable diseases.

Selected viral diseases
Marek’s disease (MD, or MDV)
Marek’s disease (MD, or MDV) is one of the more common diseases encountered in backyard chicken medicine. The causative agent of Marek’s disease is an alphaherpesvirus with numerous strains of varying pathogenicity. MDV is highly contagious and is transmitted horizontally by direct contact or indirectly through the air or by fomites (eg. feathers, dander, litter). An infected bird sheds virus indefinitely. Virus can remain infectious in the environment for many years. The disease only affects chickens. Morbidity is generally high and mortality is low. Clinical signs are most often seen in 10 to 20 week old chicks, but birds 3 to 4 weeks of age to 3 years of age can also be affected. Clinical signs include unilateral paresis or paralysis (can progress to bilateral involvement) typically between 6 and 12 weeks of age (often associated with unilateral swelling of the affected ischiatic nerve at necropsy) or lymphoma, often associated with extensive visceral or dermatologic neoplastic involvement. If mononuclear infiltrates are present within the iris, the eye may change color from yellow to a pale tan or grey. MD must be differentiated from lymphoid leukemia (LL), a retroviral disease with similar clinical and pathologic findings. Serology (eg. ELISA) and PCR are available for diagnosis. No treatment exists for MD, and as infected birds are persistent shedders, euthanasia should be advised for confirmed cases. Vaccination is standard for commercial birds, either within the egg or at one day of age. Vaccination is over 90% effective in preventing disease. Purchase of vaccinated birds for the backyard flock is advised. On-site vaccination is impractical and not advised. A 1:10 dilution of bleach inactivates MDV.

Lymphoid leukemia (LL)
Avian leukemia virus (ALV), a retrovirus, is associated with the leukosis/sarcoma group of diseases in chickens. Lymphoid leukemia (LL) is the most common manifestation of this group of diseases, but numerous other neoplastic diseases are associated with ALV in chickens. ALV is transmitted both horizontally and vertically. LL is typically seen in birds 14 to 40 weeks of age but can be seen later in life. Clinical signs are generally non-specific and include inappetance, weight loss, weakness, and diarrhea. Premortem diagnosis can be made by serology (eg. ELISA) and virus isolation. Necropsy findings include grey to white tumors on viscera including the liver. ALV induces numerous neoplasms such as erythroid, lymphoid, and myeloid leukemia as well as fibrosarcomas, hemangiomias, and nephroblastomas. Clinical and pathologic findings of LL and MD can be difficult to differentiate. However, clinical signs of LL rarely develop before 14 weeks of age, which helps to differentiate it from MD. As with MD, no treatment exists for LL. Currently no vaccine is available. The best preventative measure is to test all birds and cull all positive breeding stock.

Avian influenza (AI)
It is unlikely for avian influenza (AI), also known as “fowl plague,” to be seen in the typical backyard flock. However, sporadic outbreaks do occur, and the backyard poultry veterinarian should be familiar with this serious and reportable disease. In fact, highly pathogenic avian influenza (HPAI) H5N8 was reported in a small (about 100 birds) backyard poultry flock of guinea fowl and chickens in Winston, Oregon in December, 2014. The causative agent is a type A influenza virus, an orthomyxovirus. Transmission is through aerosol spread, ingestion, or through fomites. Clinical forms of AI range widely from low pathogenic (LPAI) to highly pathogenic (HPAI) and the signs vary widely from mild clinical illness including inappetance, diarrhea, decreased egg production, and mild respiratory disease for LPAI, to severe respiratory, gastrointestinal and neurologic signs and significant mortality with HPAI. Rapid diagnostic methods such as agar gel immunodiffusion (AGID) are generally preferred over classic diagnostic methods such as virus isolation. rtPCR is also available. Further classification is generally performed by the National Veterinary Services Laboratory (NVSL) in Ames, Iowa. No specific treatment exists for AI in birds. Depopulation is generally performed for outbreaks of disease. Vaccination is generally not practiced in the United States and is tightly controlled by governmental agencies.

Viscerotropic velogenic (exotic) Newcastle disease (vvND; END)
As with avian influenza, exotic Newcastle disease (END) is unlikely to be seen in the backyard poultry flock, but the veterinarian should be familiar with this reportable and zoonotic disease. California has experienced several outbreaks of viscerotropic velogenic
Newcastle disease (vvND) in fighting cocks and small household flocks in the last several decades. Unlike in other parts of the world, vvND is not endemic, and so is also known as exotic Newcastle disease (END). The causative agent is a paramyxovirus, which is generally spread through respiratory secretions, ingestion, or by fomites. Newcastle disease types are referred to as lentogenic, mesogenic, or velogenic. The mildest form (lentogenic) is associated with mild respiratory signs and mild generalized illness. The mesogenic form is also associated with respiratory disease and is also associated with a drop in egg production with occasional neurologic signs but low mortality. For the most severe form (vvND), neurologic signs (eg. torticollis, paresis, paralysis) may be seen along with more severe respiratory signs. Mortality rates for vvND are high. Diagnostic testing for this reportable disease (eg. rtPCR) is usually performed by laboratories in the National Animal Health Laboratory Network (NAHLN), although further classification is generally performed at the NVSL. Vaccination is considered unnecessary for backyard flocks unless there is a known exposure in the area. Exposed and infected flocks are generally depopulated.

Selected bacterial diseases

Mycoplasmosis

There are numerous mycoplasmas capable of infecting poultry species and not all cause disease. Infections with Mycoplasma gallisepticum (MG) are typically silent in chickens, although coinfection with Escherichia coli can result in Chronic Respiratory Disease (CRD) in chickens. MG causes infectious sinusitis in turkeys. MG is a reportable disease in many states. Transmission is transovarial or through aerosol or fomites. Culture is the gold standard for diagnosis, although PCR and serology can be used. Although tylosin and tetracyclines can be effective at diminishing clinical signs, no antibiotic completely clears infection. Prevention is preferable, through purchasing replacement birds only from MG free sources and through quarantine.

Infectious coryza

Infectious coryza is common in the southern United States but rare in the Midwest. It is caused by Avibacterium (Hemophilus) paragallinarum, a Gram negative rod. Chickens, pheasants, and guinea fowl are susceptible. Transmission is through aerosol, ingestion, or fomites. Clinical signs include unexpected mortality or severe respiratory signs such as ocuonasal discharge, facial edema, or swollen infraorbital sinuses. Diagnosis is generally through culture on appropriate media. Although treatment may be attempted with antibiotics such as sulphonamides, tetracycline, or erythromycin, depopulation followed by disinfection and restocking are often performed since recovered birds are lifetime carriers. A vaccine is available but seldom used for backyard flocks.

Pullorum and other Salmonella-associated diseases

Infection with Salmonella pullorum is associated with white diarrhea and high mortality in young birds, whereas adults are generally asymptomatic carriers. The disease is primarily egg-transmitted. Infected chicks that do not die can produce infected eggs at sexual maturity. Septic arthritis has been seen in some birds. Cecal plugs observed at necropsy are characteristic of the disease. Diagnostic options include culture and the whole blood plate test. Affected flocks are generally culled under supervision of state regulatory agencies. Other Salmonella species can infect poultry and are often associated with gastrointestinal signs and signs of generalized illness, such as S. gallinarum (fowl typhoid), and paratyphoid Salmonella (paratyphoid). Pullorum and fowl typhoid have been nearly fully eradicated in the United States and are reportable diseases in many states.

Selected parasitic diseases

Coccidiosis

Coccidiosis is common in backyard chickens and is caused by infection with the protozoal parasite Eimeria spp. Eimeria spp. are species-specific. There are numerous species of Eimeria (at least 9 in chickens), with cecal and intestinal forms. Most outbreaks involve infection with two or more species. Infection with Eimeria tenella (a cecal parasite) is associated with hematochezia and a high morbidity and mortality. Clinical signs include pale combs and wattles, lethargy, and shivering. Diagnosis is made through fecal examination and by histopathology. To control coccidiosis in a flock, coccidiocidal drugs or coccidiostats should be used on a semi-annual rotational basis. Control measures include using deep litter and salting the coop floor. Coccidiostats such as amprolium and sulfamethazine should be added to the feed for chicks less than 16 weeks of age.

Ascaridiasis

Infection with Ascaridia galli causes a common roundworm infection in chickens and turkeys. The nematode resides in the upper small intestines. Heavier worm burdens are more likely in birds with concurrent illness and a high environmental load. Birds less than 12 weeks of age are most susceptible. Signs include generalized illness, decreased egg production, diarrhea, and occasionally intestinal obstruction. Diagnosis is through fecal examination. Piperazine is the drug of choice, although it is somewhat weak and not intended for use in layers. Fenbendazole can be used off-label. Using litter at least 4 to 6” deep and frequent cleanings reduce exposure.
Selected non-infectious diseases

**Rickets**

Rickets is a nutritional disease that primarily affects young, growing birds. It is associated with inadequate dietary calcium, an inverse Ca:P ratio, inadequate dietary vitamin D₃, or excessive dietary protein. Nutritional deficiencies can be caused by concurrent illnesses such as enteritis and nephritis. Clinical signs include lameness, gait abnormalities, ataxia, and lethargy. At necropsy, metaphyseal flaring (thickened growth plate) of long bones, rotational limb deformities, pathologic fractures, and perosis (slipped tendon) are often seen. Beak deformities and soft beaks are also seen. The disease is reversible if caught early. Hobbles, boots, and splints can be used for early, mild limb deformities. Surgical correction may be necessary for more severe deformities, but the prognosis is guarded at best for complete return to normal function.

**Trauma**

Trauma is very common in backyard poultry, either through predator attacks (eg. dog, raccoon, coyote, owl), persecution (attacks from conspecifics), and vehicular injuries. With dog attacks, there are often bite marks or scratches on the back and sides with associated feather loss. Birds are frequently presented in hypovolemic shock from blood loss and dehydration. Treatment is aimed at restoring perfusion with fluid therapy and through antibiotic and analgesic treatments and through the repair of damaged soft tissues and bone. Wound therapy techniques described for other avian species can be used in poultry species.

**Reproductive disorders**

Reproductive disorders such as oviductal impaction, egg binding, dystocia, and yolk peritonitis are very common in female poultry seen in clinical practice. It is believed that the reproductive tract weakens with advancing age and allows excessive bacteria to enter the oviduct passively or through retrograde peristalsis. *E. coli* is often incriminated with reproductive tract infections, although other bacteria such as *Salmonella* spp. have been isolated. If fluid is present in the intestinal peritoneal cavity, or if excessive egg products have accumulated in the oviduct or peritoneal cavity, there can be a sagged appearance or a base-wide stance and enlargement of the belly with or without a palpable mass. Affected birds may be lethargic or inappetant and may be septic. Diagnosis can be made through digital cloacal exam, survey radiographs, ultrasound, and abdominocentesis. Excessive fluid can be drained and birds can be managed with appropriate antibiotics and analgesics. However, exploratory surgery and removal of retained egg products with or without salpingohysterectomy or partial oophorectomy may need to be considered for more advanced cases. Other reproductive diseases commonly seen in hens include ovarian and oviductal carcinoma and cystic persistent right oviduct. Cystic persistent right oviduct can be treated surgically.

**Suggested reading**


Greenacre CB. Backyard poultry: A crash course so you are prepared. Proc Assoc Avian Vet 2013:3–12.


Behavior is a manifestation of normal and abnormal, typical and atypical, and often related to owner’s point of view. Behavioral “sign” is recognized when the animal behaves in a way considered atypical for a given environment or event.

Disease is very often expressed behaviorally, and a good history taking is important. It is imperative to inquire about changes in severity and frequency. A disorder may possess both medical and behavioral components. Both must be addressed to ensure resolution of the problem.

**Medical vs. behavioral – need to consider BOTH when making a diagnosis**

Medical problems can lead to behavioral problems, even after medical problem is treated. Example: a true urinary tract infection in a cat – resolves, but cat still urinates outside of box. We must also consider behavioral component of medical problems.

**Major medical symptoms**
- Lethargy, anorexia. This can be seen in almost any disease process. Rule out medical problem first.
- Polyphagia. Medical problem>>or may be a component of attention seeking behavior.
- Change in elimination habits, usually when eliminating inappropriately.
- Pruritis and self-mutilation. May be medical and/or behavioral (attention-seeking, compulsive).
- Increased or decreased motor activity. Medical or behavioral, such as hyperkinesis. True hyperkinesis appears to be very rare.

**Dermatological disease**
- Causes of behaviors: Atopy/allergy; ectoparasites; trauma; dermatopathy; anal sacculitis.
- Reasons for behavioral change: ruritis; inflammation; infection; pain
- Behaviors: chronic licking (often persists after initial insult resolved, becoming a behavioral problem).

**Gastrointestinal disease**
- Causes of behaviors: IBD; blockages; motility disorders; liver disease
- Reasons for behavioral change: pain; inflammation
- Behaviors: Anorexia (Behavioral cause of attention seeking/audience affected behavior for anorexia cannot be ignored. If a dog is “picky” enough, the owner will feed it continually changing food (boiled chicken, grilled steak, etc.)); vomiting; polyphagia (see endocrine also); excessive licking.

**Urinary tract disease**
- Causes of behaviors: FIC; infection; crystalluria; estrogen-dependent incontinence; PU/PD.
- Reasons for behavioral change: pain/inflammation; incontinence; polyuria due to any cause
- Behaviors: urinating with intentional body posture (increased urge-polyuria vs. pollakiuria vs. stranguria vs. anuria) vs. incontinence.

**Endocrine/metabolic disease**
- Causes of behaviors: hyper-/hypo-thyroidism; diabetes mellitus/insipidus; hyper-/hypo-adrenocorticism; pheochromocytoma; electrolyte imbalances
- Reasons for behavioral change: alterations of hormones; dysregulation of glucose; neoplastic changes; electrolyte imbalances
- Behaviors: polydipsia/polyuria (many causes); polyphagia (many causes); disorientation, lethargy

**Cardiovascular disease**
- Causes of Behaviors: any form of cardiac dysfunction, acquired or genetic/congenital, related to rhythm or physical function, vascular disease
- Reasons for behavioral change: lack of oxygen to body and brain
- Behaviors: disorientation and lethargy

**Sensory system diseases**
- Causes of behaviors: degeneration in vision, hearing, olfaction, and taste.
- Reasons for behavioral change: unaware of surroundings; \( \cup \) ability to respond to environmental cues
- Behaviors: disorientation; fearful or withdrawn behavior; visual “hallucinations”; anorexia, “picky” eating behavior

**Musculoskeletal disease**
- Causes/reasons for behaviors: pain; paralysis/paresis
- Behaviors: increased irritability or aggression, due to pain; inappropriate elimination.
**Neurological disease**

Pain; seizures; circling; behavior change.

**Overview**

Often people confuse behavior problems with neurological problems, and vice versa. Not many 2-year-old intact males (insert least favorite breed) with aggression problems have a brain tumor! It is important to do a complete neurological exam, especially if you suspect neurological disease. Keep in mind breed predisposition for certain problems (hydrocephalus in Chihuahuas)

May be a sudden change in behavior, or may be a slower onset behavior, and it depends on disease, animal’s coping mechanism, and the critical mass of a space occupying lesion that causes the animal to start to decompensate.

Seizures are the most common presenting sign for brain tumors, but also see behavior changes (apathy, aggression, “hallucinations”, compulsive behaviors).

**Now…reverse your thinking…behavioral causes of medical problems**

**Dermatological disease**

*Behaviors and causes:* chronic licking (acral lick dermatitis); chewing/licking feet; tail-chasing -- Attention-seeking behavior; anxiety, displacement; “compulsive” behavior

**Gastrointestinal disease**

*Behavior and causes:* Anorexia or polyphagia (attention-seeking behavior, compulsive behavior); vomiting (stress, anxiety); pica (attention-seeking behavior, compulsive behavior); dementia, head pressing, uncontrolled barking (attention-seeking behavior, cognitive dysfunction; compulsive behavior)

**Urinary tract disease**

*Behaviors and causes:* squat urinating – inappropriate elimination (primary behavioral problem or secondary to medical problem/stress/FIC, cognitive dysfunction); vertical marking – marking behavior (stress/anxiety/territorial behavior).

**Endocrine/metabolic disease**

*Behaviors and causes:* polydipsia/polyphagia (stress/anxiety, attention-seeking behavior); increased activity (normal behavior for young animal, stress/anxiety)

**Sensory system diseases**

*Behaviors and causes:* disorientation (cognitive dysfunction); fearful or withdrawn behavior (obviously fearful or anxious animal to specific stimuli, generalized stress/anxiety); aggression (multiple behavioral causes of aggression); visual “hallucinations” (attention-seeking behavior; compulsive behavior); anorexia, “picky” eating behavior.
Myth Busters:
Common Misconceptions in Behavior
Melissa Bain, DVM, DACVB, MS
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Davis, CA

Perhaps more in behavior than in all other areas of veterinary medicine combined, there is a flurry of incorrect myths that are either at best unhelpful, or at worst HARMFUL, to our patients. It is important that veterinary staff know the scientific background of behavior, and to not resort to the common thought, which is sometimes incorrect. Listed here are some behavioral myths that are perpetuated amongst owners, veterinarians and staff.

“Aggressive dogs are dominant.”
Most aggression in dogs has a strong component of fear. The danger in using the commonly recommended punishment-based techniques is that dogs become more fearful, and perhaps even more aggressive. Over time, dogs can learn to suppress their fearful behavioral signs, such as tail tucked, ears back, etc., and begin displaying more offensive threats.

“Dogs pull on a leash/jump up on people/sleep on the bed/go out of doors before their owners because they are dominant.”
While some dogs that display aggression toward people also perform these behaviors, the majority dogs that perform these behaviors do so because they are untrained or just want to be closer to their owners for companionship. To get a dog to not sleep on the bed, you have to provide an appropriate place for the dog to sleep, and all family members need to be consistent in not letting him up onto the bed. To get a dog to not jump in greeting, only interact with him when he has “four on the floor”, and all people who interact with the dog need to be consistent.

There have been some popular dog trainers on television that continue to perpetuate this myth, utilizing very harsh training methods to show their “dominance”.

“The only way to train a Rottweiler/German Shepherd Dog/Labrador/insert breed is to use a prong collar/shock collar/insert tool because they are stubborn/dominant/aggressive/insert temperament.”
The best way to train any animal, again, is to reward the appropriate behavior. Certainly there are differences in behavioral traits of different breeds of dogs, just as there are differences between individual animals, but that doesn’t negate the above statement. Training methods are not breed-specific.

“My dog is aggressive towards strangers because he is protecting me.”
While in some instances this may be among other factors, more often a dog’s behavior is dependent on the handler’s behavior or presence. It is common to see a dog more confident in the presence of its owner, leading to fear being more of a co-factor. For example, if a dog is aggressive towards other dogs on leash, the average owner is going to tighten up on the leash and act anxious (rightly so!), which then alerts the dog to a potentially impending problem.

“If you use treats to train, you will always need them.”
If an animal is trained with treats, and not bribed with treats, this statement is false. Once the pet is able to perform the behavior fluently, the frequency of the reward should decrease. Behaviors are more resistant to extinction if they are reinforced on a variable schedule. Think of playing a slot machine…if you won a quarter each time you put a quarter in, it would get pretty boring. But if you won a bigger amount of money every once in awhile, you are more likely to stay and continue to play.

“Puppies should not go to puppy classes/the mall/friend’s houses until they have had all their vaccinations at 16 weeks of age.”
The primary socialization period, the time of rapid social development that sets a pattern for most things in later life, ends at about 14-16 weeks for dogs. This important period has passed by the time the dog has received his or her full vaccination series. If you recommend to your clients to wait until 16 weeks, shouldn’t you do housecalls to vaccinate puppies in their homes while wearing shoe covers and clean lab coats? I ask this because one place that a well-cared-for puppy is likely to get an infectious disease is in a veterinary hospital. This is NOT the same as recommending the puppy go to a dog park or other area where dogs of unknown health status visit, but to well-controlled areas where healthy puppy and adult dogs visit. Regarding puppies raised for seeing-eye dogs…they are socialized out in the real world at a young age, but are rarely reported to contract, much less die, from Parvovirus, Distemper, and other infectious diseases. Studies have also shown that attendance at puppy socialization classes is positively correlated to retention in the home.
“It is important to rub a dog’s nose in its feces or urine to properly housetrain it.”
The best way to train any animal, whether it is a dog, cat, horse, or child, is to REWARD the appropriate behavior by using something that highly motivates the animal, which is most often food, but can also be toys, play, or attention. Punishment is often used incorrectly. It is often overly harsh, directly related to the owner delivering the punishment, not done within a few seconds of the behavior beginning, and not consistent to properly affect the behavior.

“He urinates inside/destroys the house/barks when we leave him alone because he is spiteful.”
Animals will not display these types of behaviors for “spite”. Separation anxiety, lack of enrichment, redirected behavior, territorial behaviors, urine marking, and incomplete housetraining are just some of behavior problems that need to be explored more in depth with the owners and treated appropriately.

“Don’t bother castrating a pet after he has started marking/roaming/fighting. It won’t work because they have already learned the behavior.”
Studies have demonstrated that the same percentage of male dogs and cats are nonresponders to TREATMENT of sexually dimorphic problem behaviors as DEVELOP them if they are castrated prepubertally. For example, ten percent of male cats castrated prepubertally are reported to be problem markers AND ten percent of cats that were castrated specifically to stop problem marking continue to mark.

“This medication will dramatically help your pet with its insert problem behavior.”
While medications can be a useful tool in helping our patients overcome behavior problems, they are not a “magic bullet”. Appropriate behavior modification is an essential part of any treatment plan. A corollary is treating a cat bite abscess. Treatment with antibiotics alone, without placing a drain or putting on warm compresses, is not in the best interest of the animal, and less likely to be successful.

“All behaviorists/trainers are the same.”
In short, trainers vary widely in their techniques, abilities, dedication and professionalism. Separately, ANYONE can call themselves a behaviorist, animal psychologist, behavior counselor, or trainer. Organizations in which there are acceptable credentialing requirements are the American College of Veterinary Behaviorists (www.dacvb.org) and the Animal Behavior Society (www.certifiedanimalbehaviorist.com). The Society of Veterinary Behavior Technicians (www.svbt.org) is helping to develop a specialty in behavior for technicians (www.avbt.net). A veterinary behaviorist is a veterinarian who has advanced training in behavior. This person deals with all aspects of behavior, not just training, including anatomy, ethology, neurochemical, neurology, pathology, physiology, psychology, and psychopharmacology.

“I don’t have time to learn about behavior.”
You cannot afford to NOT know about behavior. It is an integral part of the veterinary profession. Approximately 10% of the dog and cat population in the United States are euthanized each year because of behavior problems. This can be 1 patient of yours per day. We cannot afford to ignore this situation.

“Owners won’t pay for a behavior appointment.”
This one is too often true, but it doesn’t have to be. If you charge appropriately for your time and sell your services, this should not be an issue. Some trainers charge up to $300/hour. With a veterinary office visit of $50/20 minutes, veterinarians are getting $150/hour, which is not far off from what a veterinary behaviorist charges. By looking at this as a medical procedure, which it often is, especially for those animals who need behavior modification to have it become accustomed to being handled at the veterinary clinic, it can be more ‘applicable’ to veterinary medicine.
Aggression comprises ~70% of canine cases presented to behavior clinics. But more importantly to general practitioners is that 16% of dogs have bitten their owner (Guy, et al, AABS, 2001)

While any dog can be aggressive, and is part of the normal species behavioral repertoire, there are important breed differences in the tendency for dogs to be aggressive. Terrier breeds and the classical guard or protection dogs rank high on all types of aggression, as do those most closely related to the wolf (Akitas, Huskies). Treatment of problem aggression should take breed into account, mostly related to size and potential for injury. Prognosis is based on size, overall temperament, drive, and ability of owners to take risk. Often the temperament of the owner is mismatched with the breed-typical behavior, and not just related to aggression.

**Diagnosis**

We look at our diagnoses based on the dog’s behavior and its motivation.

*Offensive or defensive* nature is based on body language at the time of presentation in response to a trigger. This can be different for different triggers. The motivations of a defensive threat are generally based on fear and/or anxiety. The motivations of an offensive threat are sometimes not as clear. A dog demonstrating an offensive threat may indeed be confident in the given situation, but it may be fearful, having learned that an offensive threat is more effective to chase the person or other dog away than demonstrating a fearful body posture, behavioral signs in this context may also be ambivalent. The underlying motivation or cause may not be known. Often is a combination of multiple causes.

When working with an owner, you should triage to determine which of the different problems it is most important to address first. If a dog is diagnosed with aggression of equal intensity and severity toward household members and toward unfamiliar people, the aggression toward household members should generally be addressed first. Even when the owner is unable to fully work on multiple problems concurrently, a recommendation of avoidance is almost always recommended in the interim, until the problem can be fully addressed.

**Risks inherent in owning a dog with a history of aggressive behavior**

Risk to people and other animals are (obviously!) inherent. Such risks include:

- Physical injury – redirected aggression, to family members if not recognized, by being physically pulled down, when attempting to stop a dog fight
- Emotional injury – stress in avoiding situations, or constantly worrying about it; conflict between family members
- Potential liability
- Separately, a risk to problem dog can occur. While not as obvious as human risk, the risks to the dog include:
  - Physical injury – from other dog or person, or from owner trying to stop the behavior
  - Emotional injury – stress in encountering the stimuli; stress in anticipating the owner’s reaction
- Relinquishment

**History and causes**

The dog can have multiple triggers and motivations, and most of the time the dog is fearful. It can be directed toward familiar and/or unfamiliar people, and could be worse (or better!) on its territory. In rare cases it could be, at least in part, be attributed to the dog being very confident. It is often due to owner/dog mismatch and/or miscommunication between owner and dog, but could also be a function of the owner's inability to control the dog, or the dog's unwillingness to accept the owner's leadership in certain situations.

Aggression is often preceded by physical or verbal punishment, disturbing dogs while resting, petting the dog, reaching for the dog, grooming it, getting the dog off the bed or furniture, taking away objects the dog has picked up, taking food away, putting the dog outdoors, approaching them, coming on their territory, reprimanding them, or anything else that can cause fear in a dog.

The very rare dog with a TRULY confident personality will also show body postures suggestive of confidence (ears directed forward, elevated tail, staring, mounting, trying to stand over family members). Those with a motivation of fear usually show signs of fear, submission, or that of mixed motivation, especially if has learned that a “get you before you get me.” Make sure you get what the dog’s body language was originally when first started…usually fear/stress/anxiety.

**Prevention**

With proper pet selection, early education, puppy socialization classes, and consistency, the problem is often avoided.
Owners should be asked to ask the dog to work for things that it wants in life from early on, using humane and non-threatening techniques. This helps develop leadership of the owner and gives the dog a consistent manner in which to interact with people. See NILIF later.

**Treatment**

Avoid the situations that have previously provoked the aggression until the owner can safely work on the situations. This is a safety recommendation, as well as a recommendation so that the dog does not continually get put into that situation and learn inappropriate behaviors.

**Hormonal treatment**

Castration of males can reduce aggression some of the time. Probability of about 30% of reducing the aggression by at least 50%.

One report suggests that young female dogs that are *already aggressive* toward owners may be predisposed to problem aggression as an adult if spayed before one year of age. Another study showed that spayed female dogs had a higher level of territorial aggression vs. intact females.

**Affection control (NILIF – Nothing in Life is Free)**

Object is to point out to the dog, in a non-confrontational manner, that its life is now predictable and safe, thus, decreasing any stress or anxiety so that the other behavior modification is more easily implemented. The dog has to obey a command (sit, down, etc.) in order to get what it wants. Affection, attention, and food are briefly given to the dog when it obeys, then the owners “turn off” and ignore the dog again. This continues periodically throughout the next two weeks, at whatever interval the owner decides upon (every few minute is fine), during the times the owner would normally be interacting with the dog. If the dog fails to respond to a command, it is not rewarded (nor is it scolded or punished).

**Desensitization and counterconditioning**

Once the owners feel more comfortable and confident in working with the dog, they can began work on those “trigger” situations which evoke aggression. The techniques used here are the same ones used to get an animal (or a human) used to a fear-producing stimulus. Important points include: 1) setting up a “gradient” moving towards situations involving increasing risk for aggressive behavior; 2) using obedience-trained behavior (sits, downs) as the target behavior to reinforce and reward; 3) avoiding eliciting the aggressive behavior; 4) rewarding only calm, relaxed behavior on the part of the dog. Goal is to decrease dog’s reaction to “trigger” situations to the point where the owners can keep the dog.

Avoid direct confrontational methods, and use non-confrontational leadership exercises. Confrontational exercises can be dangerous and instill even more fear.

This is where owners confront and “subdue” or “dominate” etc. the dog by using physical force or restraint as necessary. Many owners have already tried “meeting force with force.” Commonly suggested techniques include “Alpha Roll” or “scruff shake”. In most cases it is either ineffective, or outright dangerous, and will increase fear.

**Tools**

**Head collar**

Use a head halter so that the owner can be more in control of the dog. If necessary for the dog to be outside (i.e. in the city) and it is dangerous, the owners should also consider the use of a muzzle. If it can be safely done, the dog can have a ‘drag line’ attached to the head collar.

**Muzzle**

Muzzles should not be used to be able to force the dog into situations in which it has shown aggression or acts uncomfortable. Head halters and muzzles can give the owner a sense of confidence that they can go through with the program, and they are more comfortable that they have control over the dog and don’t feel anxious. This confidence can be transferred to the dog in a positive manner.

**Anxiety wrap/thundershirt**

For dogs that are overaroused or anxious these could be tools to help decrease these emotions so that behavior modification can be more effective.

**Medications/alternatives**

**Overview**

The underlying question has to be “why” are you using medications? Is the dog abnormal? What is the underlying reason for the aggression…fear? impulsivity? There are no medications, nor will there ever be, licensed to treat aggression in dogs, or people for that matter. The owner’s perception of the problem often clouds the diagnosis and perceived need for medications.

Before prescribing a medication to an aggressive animal you must: have a diagnosis; make sure the owner is following appropriate safety measures; and certify the owner works on an appropriate behavior modification program for the aggression.

“Traditional”

SSRI’s and TCA’s are usually the first choice of medications to help facilitate treatment.
“Alternative”
Dog Appeasing Pheromone/Adaptil is an option to help decrease arousal. There is some benefit for some dogs.
History and causes
Separation anxiety is a normal reaction to being abandoned starting as puppies. Most dogs are desensitized to separations as they mature.

As with most problems, separation anxiety exists on a spectrum, as a problem behavior ranges from mild to severe. Symptoms range from mild to severe. Mild signs may be ignored by the owner if they do not know what they mean. Such signs include drooling, inappetance, pacing, and whining. The owners usually seek help when the signs become severe. Such additional signs are barking, howling, destruction (usually around entryways/windows, or of owners’ personal objects), inappropriate elimination, and/or escape.

These signs only occur when the owner is not present. It may occur when all people are gone, or just when the owner that the dog is most attached to is gone. Usually signs occur within the first few minutes of the owner’s departure, and can occur cyclically throughout the day. It can also happen if the owner is out of sight of the dog.

These signs can also occur as manifestations of other problems; the main diagnostic feature is that these signs occur only when the owner is gone. Sometimes owners give excessive attention to the dog prior to departures and upon returning which may enhance the contrast between the owner being at home and away.

Treatment
Differentiate separation anxiety from other types of anxieties (noise phobia), barrier aggression/frustration, attention-seeking, confinement anxiety, lack of stimulation, inappropriate elimination, urine marking, cognitive dysfunction. Almost essential to diagnosis is videorecord the animal when the owner is completely gone. Options are webcams, cell phone, or digital camera videocameras.

May have to set up different situations, different locations, with and without other household dog(s), different times of day, etc. Counsel the owners on the problem. The dog is not doing these behaviors “out of spite” or because “he’s mad that we left him.” This is panic and the animal is in distress. It is a difficult problem for a lot of owners to handle, but they can work through it.

Have the owners implement a command-response manner of interacting, so that the dog has a more stable relationship with its owner. It also helps stabilize its anxiety.

It is important to eliminate the anxiety that the dog feels when it is left every day. If at all possible, have one of the owners take him to work with them, find a doggy day care in their area, board the dog at your clinic, or have the dog spend the day at a friend’s house. The reason behind this is so the dog doesn’t continue to panic in their house, continually relearning these reactions and behaviors there.

Begin implementing “independence exercises”. Choose a place, such as a special mat, which will be used for this part of the program. Put the dog on the mat and have him stay, giving him a long-lasting yummy food treat that he only gets when the owner is separated from him. Start out with a short period of time and a short distance away. This could be as short as 2-3 seconds and 2 steps away if necessary. Then release him/her. Gradually increase the length of time the dog stays on the mat, up until about 15 minutes or so. The owners also need to increase the distance they move from their dog during the stay.

Eventually they will be able to move into another room while the dog is staying on the mat. If they can’t go to the bathroom by themselves, they can’t leave the house. Start with just a second or two, then increase the time away, and gradually they should close the door behind them. Once that is accomplished, they can work toward stepping out of the house while the dog stays. They should start getting closer to the door, touching the door, jingling the handle, opening the door, etc., etc.

They should move the mat around to different areas of the house and even outside when they want to work with the dog there. When the dog is on the mat for a longer period of time, they should give him a toy smeared with peanut butter or other long-lasting treats. This makes it pleasurable to be on this mat. Take this toy treat away when the down-stay session is over.

When the owners start getting ready to go outside do not initially use a food treat, as it can become a cue for the dog. When the dog starts to become more comfortable with departures, reintroduce food treats. Progress on departures will be slow at first, increasing by only very gradual steps: 1,2,1,2,3,2,1,4,2,5--minutes. Later the steps will be much greater after the dog can be left alone for 30 minutes (e.g., 30, 45, 15, 60, 45, 30, 60, 75--minutes).

The owners should downplay their departures and returns. Actually ignore the dog completely for 15 minutes before they leave, and until the dog is gradually more relaxed after they return home. This is hard for most people to do, because the dog is so happy (and frantic!!) to see them. The dog may try even harder to get their attention when they first start to do this, but have them try to
preoccupy their time with something else when they first arrive home, so that they aren't as likely to give in to the demands for attention.

If there is a big difference between the amount of attention that they give the dog on the weekends and the weekdays, try to minimize this difference, so that there is not such a stark contrast between the two.

Another component of the behavior modification program involves desensitizing the dog to departure cues, such as the owners putting on their shoes, picking up their keys, etc. Often this is not effective, as the dog knows when the owner is really leaving. If owners are willing to try this part of the plan, on the days they are not leaving (at least at their regular time), they should go through their whole normal weekday morning routine, but don't leave the house. This should make the dog less sensitive to the departure activities, so that the dog will learn not to associate them with them leaving it alone. However, most dogs know for certain when owners are leaving or not, so don’t focus so much on this part of the plan.

**Medications**

Antianxiety medications are often necessary to facilitate behavior modification.

**Serotonin enhancers**

Only one drug remains licensed to treat separation anxiety...Clomicalm ® (clomipramine), a tricyclic antidepressant (TCA). Dose: 2-4 mg/kg/day, once or divided BID.

Other medications that are frequently utilized are those in the SSRI (selective serotonin reuptake inhibitor) family. Such are fluoxetine (1-2 mg/kg once daily), sertraline (1-3 mg/kg once daily), and paroxetine (1-2 mg/kg once daily).

Both clomipramine and fluoxetine have demonstrated benefit based on placebo-controlled studies.

**Benzodiazepines**

While SSRI’s or TCA’s can take up to 4-6 weeks to see the full effect, we may also medicate the animal in the interim with a benzodiazepine. Such are alprazolam (0.05-0.1 mg/kg, up to TID) and diazepam (0.5-2 mg/kg, up to TID).

**Pheromone**

Dog Appeasing Pheromone (DAP/Adaptil®) has been shown in placebo-controlled trials to have some benefit in decreasing anxiety in some dogs.

**Other medications**

Clonidine and trazodone have shown benefit for some dogs in decreasing anxiety based on open-labeled and retrospective trials.
Behavioral problems often elicit high emotions among owners and veterinary staff. Owners often have been dealing with these problems for a long time and, for reasons that are real for them, now feel that they have an emergency.

Four options
In all of veterinary medicine we have 4 options:

- Do nothing
- Find the fairy godmother/shelter/home on the farm that will take this pet and treat it humanely, not let it bite anyone, and not sue me if it does (or corollary ‘fix the broken leg/treat the diabetes’)
- Euthanize
- Do something

Do nothing
Not an option in veterinary medicine

Find a new home
Rehoming an animal with a history of a problem behavior is risky at best, both for the safety of people and the particular animal I question, as well as other animals that it may encounter. The animal may be at risk for inhumane treatment or yet another rehoming. Animal shelters and rescue agencies are often over-run with pets available for adoption and may have limited resources to rehabilitate a pet with a problem behavior. Of course there are shelters and other organizations that can and do work with the animals to make them adoptable and offer support to new adopters, and if an owner is going to rehome a pet, they need to do their due diligence.

Owners also have to consider the potential liability that they face if they rehome a pet with a history of aggression. They should be counseled to consult with a lawyer, or at least their home owner’s insurance company.

Euthanize
If an owner is not able or willing to work with the pet, or to find it a new home, then euthanasia is the only viable option.

Do something
These options vary widely, from pure management to full behavior modification.

Imagine a ven diagram with three things that affect recommendations…the animal, the environment, and the owner. We need to look at the intersection of these three when evaluating the situation and, while they are separated into different sections, they occur interchangeably.

Animal factors
- Size
  This affects the owner’s ability to control the dog, as well as the increased danger that it poses to others if it were to bite a person or another dog or animal.
- Breed
  Humans have bred dogs for many years for specific purposes. If an owner complains about their Border Collie herding their children, it will be difficult to stop this behavior. Likewise, if an owner comes to you with their Pit Bull-type dog for fighting with other dogs, it will be difficult to stop this behavior as well, as they were bred to fight dogs. Owners of Pit Bull-type dogs may also feel more scrutiny from the public, therefore, they may feel more pressured to euthanize their dog.
- Age of onset
  If the behavior started at a young age, there could be a stronger genetic predisposition vs. another animal for which the behavior started at social maturity. Likewise, if the behavior started at an older age, there is a higher likelihood that there is an underlying medical condition predisposing it to a behavioral change.

Diagnosis and motivation
It is up to the veterinarian to determine the diagnosis and motivation for the animal’s problem behavior. Most cases of aggression are due to an underlying motivation of fear. However, some dogs have been continually punished for expressing any type of aggression, such as growling, so that eventually the dog doesn’t display ANY warning sign, but instead goes directly to biting someone.

Rarely do dogs display aggression based purely in confidence. However, if you diagnose a dog with this motivation, the prognosis is much poorer for a more complete resolution of the problem. Additionally, there are breeds with a stronger genetic predisposition for some behaviors (terriers bred to hunt rodents—kill the pet rabbit; Border Collies bred to herd—nipping the kid’s heels), which make it more difficult to manage. Predatory behavior is a normal (but unacceptable) behavior, and can be very difficult to manage.
Animals can also have severe anxiety that must be medically managed. If an owner is resistant to treating the animal with medication, it will suffer.

**Bite inhibition**

It is a much worse prognosis if the animal has bitten, and bitten hard, than if the animal growls over many things, but it never escalated beyond a growl. It is not necessarily true that the bite severity increases over time, but it could if the owners continue to ignore the early warning signs.

**Environmental factors affecting the decision**

**People and pets in the household**

Children, elderly, infirm people, and other pets MUST be kept safe, both physically as well as emotionally. The presence of any of these factors makes for a poorer prognosis. Also, other pets need care and time with their owners, and behavior modification of the pet with the problem can interfere with that.

Cats in multi-cat households are more likely to urine mark. Feeding outside/feral cats can also contribute to this problem, and if an owner is reluctant to stop this practice, the prognosis for resolution of urine marking is worse.

The people living in the house have to buy into the program of working with the pet. It could be due to biases, or it could be due to a broken bond with one of the owners.

**Location of the home/type of home**

Do the owners live on 2 acres of fenced property in the country, or do they live in a studio apartment in the city? Can the dog go outside to eliminate? Or does it have to be leashed multiple times per day to be taken outside to eliminate, encountering noises, people, and other dogs? The neighbors and community also can affect the decision, especially if there are certain emotions around specific breeds like Pit Bull-type dogs.

Cats require a good amount of space per cat, and the more cats that are living in a house, the more likely there will be a cat with inappropriate elimination. Depending on toileting preferences, some cats prefer carpeting, while others prefer hardwood, and the presence of one or the other can affect the prognosis.

**Predictability of triggers**

Owners often claim that they cannot predict when an animal will display the unwanted behavior, but when asked specific questions, often can identify what happened before the animal displayed the behavior. However, it gets very problematic if they truly cannot identify the trigger, or if the trigger remains relatively similar, the animal reacts only some of the time, leaving them to wonder “when” it will actually happen.

**Avoidability of triggers**

Also the avoidability of the triggers is important. Some things are avoidable, such as aggression just around a rawhide or only at the veterinarian’s office. It is very problematic if the triggers are unavoidable, such as petting, any type of food object dropped on the ground (especially if there are children in the house), looking at, walking by in the house, or whatever else is not avoidable for a specific owner.

**Owner factors affecting the decision**

**Previous experiences**

We can never truly understand how previous experiences affect a person’s view on things, and have to understand that, at least to a point, that perception is reality. One owner may have been bitten severely as a child, thus, not able to take risks, while another grew up in a house with rescue dogs and NO pet should ever be euthanized for behavior problems.

Owners are also exposed to a lot of incorrect information, perhaps more so in behavior. Celebrity trainers and television personalities color what an owner thinks about pets, especially when television shows an animal ‘magically’ improved over the course of a 30 minute episode, not considering that it is heavily edited.

**Ability to take risks**

This is an individual decision. We cannot live in another person’s home, and what they can or cannot risk. Some owners are unable to take ANY risk, such as ‘my dog can never, ever growl at my son, ever.’ Some others take risks that no one else would, such as ‘even though my dog killed my other dog, I will do everything to keep him alive.’ If an owner is taking an unwarranted risk, such as not supervising interactions between a dangerous dog and a child, we are obligated to protect those who cannot be protected. This can range from having a serious (and documented) conversation with the owner, to reporting the situation to authorities.

**Time**

Owners have time constraints on what they are able to accomplish regarding behavior modification for their pet. For some owners it is a major concern, and sometimes this barrier can be overcome with behavior modification appointments that you and your technician staff can implement.
Expertise
Pet owners usually do not have the expertise that you or other animal care professionals have. Timing in the delivery of a reward is difficult to impart to owners. The ability to identify body language and vocal cues is also something that takes time to learn, even for veterinary staff. Videos, websites, and printed material can help owners identify the earliest warning sign that an animal is uncomfortable, which will allow them to avoid having the animal needing to go to more extreme measures.

Emotional blackmail
“My cat is ruining my furniture and this is the last straw!” “If my pet doesn’t stop x/y/z I’ll have to rehome/euthanize him.” These are some of the least favorite words a veterinarian wants to hear. But these are likely some of the least favorite words an owner wants to say. A lot of owners are suffering when they have a pet with a problem behavior and it may look callous and heartless when an owner brings in a ‘perfectly healthy animal’ in for euthanasia.

Sometimes there is little that can be done at this time, as the human-animal bond is broken beyond repair. Sometimes you can talk with these owners to have them consider working with their pet. However, the BEST thing that you can do is PREVENT these problems from occurring. Ask your owners each and every visit about the behavior of their pet. As in all other areas of veterinary medicine, an ounce of prevention is worth a pound of cure.

Asking the owner of the rambunctious 8 month old Pit Bull about how things are going on walks may get them to open up about how hard it is to walk him. THAT is your opportunity to help the owner by referring them to a good trainer to work on the problem then, versus them bringing the dog in for euthanasia because he jumped on their grandma and knocked her over.
We all understand the frustration that veterinarians and owners feel when an animal doesn’t follow post-op instructions of ‘don’t move’ and ‘stay crated’. Not only is it difficult for owners to understand the potential downfall of not following instructions, it is also difficult for some animals to handle such requirements.

**Prevention**

Like in all areas of veterinary medicine, an ounce of prevention is worth a pound of cure. It is imperative that ALL staff in veterinary practices need to follow low-stress handling practices. There are a lot of opportunities for veterinary staff to learn and practice these techniques to improve the welfare of the animals in the practice. Additionally owners WILL mimic what you do, and they need to be able to handle their pet in many different situations.

The additional step staff should be implementing is teaching owners how to perform specific procedures that need to be done in a home situation, both to prevent problems from occurring, as well as to help owners deal with the immediate procedures at hand. For example, if an owner is taught how to clean out their dog’s ears, they will catch the ear infection much earlier than those who do not perform these procedures.

**Crate training**

Crate training ahead of time will dramatically improve a dog’s ability to cope with post-surgical confinement. Most people have heard of crate training but may not know what it really is or why it works. The following is a brief discussion about crate training, how to use it, and some common mistakes made. Crate training takes time, effort, and a lot of patience, but when used properly, it can be a positive experience for both the owner and their dog.

**Why?**

Crate training is a great way to limit a dog’s mobility while it recovers from surgery. It will cut down on the number of times he has the opportunity to become too active and risk injuring himself. It will give the owner more peace of mind and freedom to be away from home during its recovery. If he is used to being crated it will also be easier and less stressful for him to travel, to be in a cage at the veterinarian, or to be confined for any other reason in the future. The owner may choose to continue to use the crate into the future as his very own comfortable “room”.

In the wild, dogs naturally seek out dens for sleeping quarters. Presumably this is because it gives the dog a sense of security. Dogs instinctively do not like to soil in their dens and will go outside to eliminate. Crating your dog is simply using his instinct to rest in his den. Some people feel apprehensive about crating their dog, thinking that it is mean and that their dog won’t like it. However, since dogs seek out dens on their own, a crate can be both natural and comforting.

**What type of crate?**

Both wire and plastic crates are available. Both work well, so it depends on an owner’s personal preference. Keep in mind that plastic crates can be used for airline travel while wire crates may be collapsible, thus easier for storage. Getting the right size is very important. The dog should be able to stand up and turn around freely in his crate, but it should not be big enough for him to have a separate toilet area.

**Steps in crate training**

First, make sure the crate is comfortable by placing a towel or bed inside. Place the crate in a common area and put toys and treats inside for the dog to discover. Never force a dog into the crate, as going in should always be a positive experience. Praise him every time that he goes into the kennel.

After he is comfortable going inside his crate for treats, beginning feeding his meals inside the crate. Start closing door while he is eating, but open it before he is done. Next, leave the door closed for longer increments of time, building slowly. Never open door when he is whining or scratching, but only open it when he is quiet. If he is consistently whining, he is being closed in for too long, so go back to an amount of time he tolerates well and increase more slowly.

After that, start crating him at other times besides his meals. Always give him an incentive to go into the crate (treats, food-filled toys, such as a Kong®, etc.) First stay in the room with him and then start leaving the room for short increments of time, building very slowly. Once he handles this well you can start leaving the house for short periods of time, again slowly increasing length of time. The length of time it takes for an individual to learn varies from dog to dog, so remember that patience is the key to a dog’s success.

**Problems and common mistakes**

- **Crate too small or too big:** If a dog’s crate is too small, he will not be comfortable inside, and therefore crating will not be a pleasant experience for him. However, if it is too big, he may use part of it as a toilet.
• **Forcing dog into crate:** Forcing a dog inside can be scary for him, making him associate crating with an unpleasant experience. Crates should NEVER be used as punishment. Always have safe toys or treats inside to have it be a pleasant, rewarding experience for him.

• **Moving too fast:** Baby steps are very important! Slow shaping of behavior is imperative for success.

• **Leaving inside for too long:** Even with proper training dogs need to go to the bathroom frequently and can’t be expected to “hold it” for extended periods of time (e.g. overnight, all day while at work). If your dog is having accidents in the crate it’s most likely not his fault—he just needs to be let outside more frequently.

• **Whining:** Ignore a dog when he is whining or barking in crate. This means no positive or negative attention. Letting him out will train him that he can get out when he cries, and scolding him will be confusing or even rewarding to him since what he really wants is the owner’s attention!

• **Using a crate to manage anxiety:** If the dog has separation anxiety or other anxieties, crating him may stop the house from being destroyed, but it likely does nothing to decrease his anxiety, and it may make a dog even more anxious. For example, he may break his teeth trying to chew his way out or rip out his nails trying to dig his way out. If a dog has anxiety problems, they need to work on this problem with help from you or a veterinary behaviorist, perhaps necessitating the use of anti-anxiety medications.

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**Litterbox management**

Post-op care of cats often include a change in the area of elimination for cats, and/or a change in the substrate or litterbox. Ideally a cat should be given that choice pre-op so that it is not a shock to them when they come home from the veterinary clinic.

**Type of litterbox**

Cats often have limited mobility post-op. Short-sided litterboxes, such as baking sheets, could be used in the short term so that they can more easily enter into the box. It should also be located close to where the cat spends its time, so that it does not have to travel far to eliminate.

**Litter**

Veterinarians often recommend non-clay litter post-op, so that the litter doesn’t stick to the wound. However, cats sometimes have strong preferences for specific types of litter, and a change in the substrate can lead to a cat developing inappropriate elimination on another substrate. There are different types of non-clay litter, including paper pellets, pine pellets, and shredded paper (commercial or ‘homemade’).

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**Quiet enrichment**

It is one thing to ask owners to not let their pet move for 6 weeks, it’s another to expect a pet to actually enjoy that. It is important to understand that if you tell owners that their dog can’t do x/y/z, while not giving them anything that they CAN do, they will make up that ‘can do’ list on their own.

**Food-dispensing tools**

The reasons for using these tools include giving the animal something to do when the owner is not present, and letting the animal “forage” for its food, which is more ethologically correct than eating its full ration out of a food bowl, even though our pets adapt well. Animals spend a good portion of their day hunting (carnivores) or foraging (herbivores) for food, which they are not able to do when they are fed their ration out of a bowl.

Animals could be fed their entire daily ration in these tools. Things to recommend to owners are for them to start out easy for the animal, gradually increasing the difficulty for the animal, and using larger quantities of the tasty treats at the beginning.

Self-play toys are especially good for pets which are crated for long periods of time. A lot of self-play toys dispense food, which motivates the pet to play with the toy. The basic principle is that you fill up the toy with food, and the pet learns to manipulate the toy to release the food out of a hole. Some examples are: Kong toys®, Roll-a-Treat Balls®, Deli Dome®; and Pavlov’s Cat®. Owners can make their own toys with such objects as racquet or tennis balls, or disposable water bottles with plastic lids. Cut a hole into the ball or container, fill it up with dry kibble, and, presto, the pet is entertained.

Caution must be taken when recommending these types of toys for your clients to use. Certainly take into consideration dietary restrictions for that pet. Safety must also be taken into consideration, so that the animal does not injure itself or swallow part of the tool during vigorous chewing or become overexcited, thus, defeating the purpose of being kept quiet.

**Solitary tools**

In addition to the food-dispensing tools, there are other types of things that animals can use when they are alone. Such things include visual enrichment, odors, and other types of toys. Some animals may enjoy watching television, and there are some videos available for purchase for pets to watch. However, perches by windows with bird feeders outside may provide more enjoyment for some pets. Be aware that roaming cats may be attracted to the yard, and become a trigger for the household cat to begin urine marking.
Odors can also enrich the environment of some animals, especially when taking kenneled animals into consideration. Odors, such as lavender, may provide some calming effects. Music and/or other radio sounds may provide enrichment or calming effect for some pets. Take into consideration the volume of the noise, and be aware that, while pleasing to us, some odors are aversive to animals.

**Human interaction and training**
A human’s interaction with a pet is a very important way in which an animal’s life is enriched, as the human-animal bond is secured. Some pets prefer to just be petted and handled instead of playing, especially as their physical ability to do so decreases. Some animals would prefer training. There are many quiet types of behaviors that can be taught, such as lie down, etc.

**Intervention**
Depending on the medical procedure performed, different handling techniques should be highlighted. Overarching all of this is proper pain control…if something is painful, no amount of behavior modification will make this animal tolerate it.

Some processes that need to be done could be: wound care and bandage changes; physical therapy and rehab; expression of the bladder; changing of bedding.
Overview of the Behavior of Backyard Livestock
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Backyard livestock are becoming more popular with ‘urban farmers’ and those who want a ‘different’ pet. They range from those kept only as pets, to those that are utilized, at least in part, for some commodity, whether it be milk or eggs. While there are certainly many similarities in their biology to other animals, there are certain differences that need to be understood.

Legality
It is imperative that the owner seek out whether they can keep their pet legally at their location. Some cities have strict rules regarding what animals are considered ‘pets’. However, in the past few years, some municipalities have changed the rules to become more lenient. For example, the Backyard Chicken movement has taken off, especially as people seek to be closer to their food sources.

Veterinary care
Owners are often not fully aware of the medical care necessary for proper care of these animals, nor are veterinarians. Information on vaccination protocols, nutritional needs, and common husbandry procedures should be coming from the veterinarian, not the feed store. Husbandry and management issues in livestock, just like in most other types of animals, are at the root of a lot of common medical and behavioral problems.

However, as these animals are used for food, we have to be aware of what the withdrawal times are for prescribed medications. We also have to be aware whether or not the medication is even allowed in a production animal. Even if the animal is 100% a pet, you are legally obligated to give the owner this information, and make sure your documentation is legally correct.

Pain management
Common veterinary procedures, namely castration, dehorning/disbudding, and tail banding, cause pain. Historically pain control in livestock has been lacking, and veterinarians are still slow to adopt proper measures to control pain in livestock. It is imperative for us to alleviate pain in all animals, regardless of their use. Disbudding is considered less painful than dehorning, as it removes the tissue forming the horns before the horn becomes bony and attached to the skull. Even so, pain control is necessary.

Diet
Each species has its specific dietary requirements. For ruminants and swine, fiber is an important aspect of their diet. In production systems, carbohydrates play a bigger role in their diets due to animals gaining weight quicker with the higher calorically dense diets. They walk a fine line between providing enough fiber to allow for proper rumination and enrichment, while getting the animal to market quicker or producing greater amounts of milk.

Feed is often offered in pelleted form. While providing enough fiber to be biologically correct, they consume this feed relatively quickly. Aside from being more appropriate, long-stemmed hay and straw provides the animal opportunity to perform species-typical behaviors, such as grazing and rooting. If and when an owner is unable to feed long-stem grasses, they can offer the diet in enrichment objects that allow them to spend more time consuming food.

Obesity
This is usually not a problem in production animals, as producers balance cost of the feed with the output. However, obesity is a very common problem in backyard livestock, as it is in companion animals. “Backyard livestock” are the same breeds that are used in production, and for years, animal scientists have bred these animals to be very efficient in feed conversion. Vietnamese Potbellied Pigs, and other similar breeds, were historically (and continue to be) bred for meat in other countries, and are very prone to preferably put on fat vs. muscle. Additionally, bags of feed do not come with feeding suggestions, as is found on bags of dog and cat food. Owners often supplement with grain and other treats, which quickly can lead to weight gain in these animals. However, utilizing SMALL bits of treats for training and other enrichment is appropriate if done correctly.

Social: Between animals
These behaviors differ between species, but some general rule apply. Introducing new animals to groups of animals can be challenging. Assure that there is adequate space for each animal, as well as enough feeder and waterer space. An enriched environment, such as when provided with long-stem hay and straw in ample space, allows animals to spend their time rooting, browsing, and/or grazing, and not in agonistic interactions.

Pigs are unique in that they are very physical in their interactions with other animals, likely due to the fact that they display little in the way of body language and facial expressions. This behavior is more likely to be seen when animals are first introduced to each other.
Goats and sheep that retain their horns can inflict damage to other animals, as well as people. Those animals with horns will be higher in the social rank than those that are dehorned.

**Social: Toward people**

Small ruminants are prey species, and are more likely to escape than fight back, unless they have no other choice. Utilizing low-stress handling methods is essential, regardless of what you need to do, and regardless of the species. This is starting to filter into the production end of veterinary medicine. Physiological and behavioral parameters, including weight gain, feed conversion, and milk production, point to it being beneficial.

Aggression or other agonistic interactions from animals to people are complaints that owners have. It usually is due to the underlying motivation of fear. Some animals are territorial, which can be a problem when a person enters into its pen to clean it. They can also display maternal aggression if they have an offspring with them that they are guarding.

Even though most aggression has at least some basis in fear, these animals can still be dangerous. Small ruminants can butt and, if they still have horns, can cause significant injury to a person. Swine will bite, often as their first line of defense.

**Further reading**

Animals are exposed to stressful situations throughout their entire lives. Not only animals in confinement encounter stress, such as in kennel or shelter situations, but those in households do as well. Behavioral enrichment helps decrease some of the stresses that the animals encounter, as well as playing a direct role in preventing and treating problem behaviors.

**Stress in animals**
There are many things in an animal’s life that can cause stress and anxiety. Certainly veterinary visits cause stress, whether directly due to the medical condition, especially those causing pain or discomfort, but also due to handling and restraint. Kenneling an animal, whether short-term in the hospital or longer-term in an owner’s house after orthopedic surgery, for example, is also stressful. Specific stressful things about confinement away from home can include: the actual confinement itself; change in diet; separation from the family members; proximity to loud and/or aggressive animals; noise; change of routine; and even just having people walk by the cage and not interact with it. Confinement at home for long periods of time, especially for young, active, or anxious animals, or those that have never been crate-trained, is also stressful.

Stressful situations specific to long-term confinement in shelters are often related to the things mentioned above. However, lack of environmental enrichment also plays a large role in perpetuating stress in these animals.

**Signs of stress**
Acute stress can manifest itself with signs of sympathetic nervous system activation. Some examples are: dilated pupils; piloerection; increased fear and/or aggression; inappetance; and vocalization. Chronic stress is often more insidious in nature. Some of the signs seen during acute stress can be present. However, some animals that are chronically stressed can develop repetitive behaviors, such as circling, excessive grooming (i.e. acral lick dermatitis), and pacing. They can also be more likely to develop an illness, especially if they are exposed to multiple stressors.

**Enrichment**
One main purpose of enrichment is to help reduce stress in animals. By enriching an animal’s environment, it helps the owner develop a consistent and pleasant manner in which to interact with their pet, gives the animal something to do, both with the owner and when the owner is not present, and helps animals expend physical and mental energy. It also allows the animal to display more species-typical behaviors. Enrichment tools include: food dispensing tools or long-lasting food tools; solitary tools; human-interactive tools; and human interaction.

**Food-dispensing tools**
The reasons for using these tools include giving the animal something to do when the owner is not present, and letting the animal “forage” for its food, which is more ethologically correct than eating its full ration out of a food bowl, even though our pets adapt well. Animals spend a good portion of their day hunting (carnivores) or foraging (herbivores) for food, which they are not able to do when they are fed their ration out of a bowl.

Animals could be fed their entire daily ration in these tools. Things to recommend to owners are for them to start out easy for the animal, gradually increasing the difficulty for the animal, and using larger quantities of the tasty treats at the beginning.

Self-play toys are especially good for pets which are left home alone while their owners are away. A lot of self-play toys dispense food, which motivates the pet to play with the toy. The basic principle is that you fill up the toy with food, and the pet learns to manipulate the toy to release the food out of a hole. Some examples are: Kong toys ®; Roll-a-Treat Balls ®; Deli Dome ®; and Pavlov’s Cat ®. Owners can make their own toys with such objects as racquet or tennis balls, or disposable water bottles with plastic lids. Cut a hole into the ball or container, fill it up with dry kibble, and, presto, the pet is entertained.

Caution must be taken when recommending these types of toys for your clients to use. Certainly take into consideration dietary restrictions for that pet. Safety must also be taken into consideration, so that the animal does not injure itself or swallow part of the tool during vigorous chewing. In addition, pests and vermin should be controlled if these tools are left about in the house or outside. One should strive for a balance between extremely tasty (and perhaps fattening) and nutritionally balanced food.

**Solitary tools**
In addition to the food-dispensing tools, there are other types of things that animals can use when they are alone. Such things include visual enrichment, odors, and other types of toys. Some animals may enjoy watching television, and there are some videos available...
for purchase for pets to watch. However, perches by windows with bird feeders outside may provide more enjoyment for some pets. Be aware that roaming cats may be attracted to the yard, and become a trigger for the household cat to begin urine marking.

Odors can also enrich the environment of some animals, especially when taking kenneled animals into consideration. Odors, such as lavender, may provide some calming effects. Music and/or other radio sounds may provide enrichment or calming effect for some pets. Take into consideration the volume of the noise, and be aware that, while pleasing to us, some odors are aversive to animals.

Self-play toys that do not dispense food are not nearly as exciting for the average pet. However, for example, some cats find balls on springs or a wall- or door-mounted Cat Dancer ® (rolled cardboard paper pieces on a spring coil wire) irresistible.

**Human-interactive tools**
Interactive toys help strengthen the bond between the owner and the pet by letting them share fun and positive experiences. Both owners and cats can have a great time playing with wand-type toys with strings, feathers, and fabric attached, or even just wadded up pieces of paper.

Dogs often enjoy games of fetch or tug-of-war. Care should be taken to make sure that the dog does not aggressively guard the tossed toy, as well as not display aggression when playing tug-of-war. Despite what is mentioned, tug games to not cause aggression, but can exacerbate it if the dog is already aggressive. Owners must learn to play safely with their pet.

A controversial toy is the laser pointer. While they can be a source of exercise for pets of owners with limited mobility, care must be taken to not overuse it, and to watch the pet’s reactions closely, as some animals can become very intrigued by ALL moving lights, to the extent of “obsessively” searching for them.

**Human interaction**
A human’s interaction with a pet is a very important way in which an animal’s life is enriched, as the human-animal bond is secured. Some pets prefer to just be petted and handled instead of playing, especially as their physical ability to do so decreases. Some animals would prefer training.

**Training techniques**
The majority of animal benefit from some sort of training, whether it be from attending a class or from the owner following instructions found in a book. When an animal learns to follow a command from an owner and is consistently interacted with and rewarded, it is able to develop a closer bond with the owner. Training techniques involve any combination of the following: positive and/or negative reinforcement; and/or positive and/or negative punishment. Reinforcement increases the chance of a behavior occurring in the future. Punishment decreases the chance of a behavior occurring in the future. Positive means the *addition* of something. Negative means the *removal* of something.

- **Positive (+) reinforcement:** clicker training, food or toy rewards
- **Negative (-) reinforcement:** Head collar, horse bridle
- **Positive (+) punishment:** physical punishment, choke collar, remote punishments
- **Negative (-) punishment:** “time out”

When referring to a trainer, do not rely only on word of mouth, and never rely just on an advertisement of “positive reinforcement used”, as they also may use coercive techniques as well. Visit every trainer that you are referring to, and make sure that you are comfortable with the techniques that they use for training animals, since YOU AND YOUR COLLEAGUES are responsible for the physical and mental well-being of your patients. A good rule of thumb when referring to a trainer is never refer to someone who uses techniques that you would not want to see used on a child. There are a lot of excellent trainers around, and a lot of trainers that use excessively harsh and cruel techniques.

Training tools are just that – tools. They are not magic in and of themselves, but allow people to perhaps make the animal do something that they may not readily do. They can be broken down to: leashes and collars and those products that deliver a punishment, such as remote punishments and booby traps. The more humane tools available are: head collars; front-attachment harnesses; and clickers.

Various forms of successful outlets for training are available. They can be from the basic obedience class to more advanced ones, such as agility, flyball, tracking, lure coursing, and even dancing. Just as there are various outlets for training, there are many ways that trainers work with their clients. One increasingly common method is by using “clicker training”. This allows a person to use a bridging stimulus (the clicker) to mark the exact moment an animal performs a correct behavior, allowing some time to get the reward to it.

Even cats can be taught any number of tricks, from “sit” to “down” to “wave.” To be successful, you must use positive reinforcement methods (such as clicker training) since most cats cannot be forced to do something they don’t want to do!
Summary
In summary, the stress level in animals can be greatly reduced by incorporating behavioral enrichment into their lives. It helps foster a better relationship between the owners and their pets, as well as help decrease the incidence of problem behaviors.
In this presentation an overview of pathological self-injurious behavior (ESMS) is being discussed. Epidemiology, classification and clinical aspects and pathogenesis are presented. The importance of comprehensive assessment of symptomatology and functions of ESMS for treatment planning is discussed.

Equine Self-Mutilation Syndrome (ESMS): Behavioral or medical?
Pathological self-injurious behaviors (SIB) are recognized in many different species, including humans. They are self-directed, socially unacceptable, repetitive behaviors that cause minor to moderate physical injury. The terms "physical injury" and "mutilation" are often used interchangeably. It has been suggested in the study of the pathogenesis that some of these behaviors seems to be pathological similar to displacement activities or grooming behavior. Interestingly, experimental research results show that the administration of amphetamines results in self-mutilation in mice, rats, horses and dogs. Painful stimulation causes an increased release of endorphins in humans and in mice, indicating that the opioid neuropeptide regulatory system may be affected. It has also been suggested that heterogeneous disorders, for example OCD, may have to be considered as a continuum or comorbidity of this disease process. The dopaminergic system has been reported to be involved in Gilles de la Tourette syndrome with 50% of patients with SIB (1).

First described in horses as self-directed aggression, clinical signs include glancing or biting at the flank or pectoral areas, bucking, kicking, vocalizing, rubbing, spinning, or rolling. In stallions, castration was associated with improvement of this behavior (2). The prevalence of ESMS in the equine population is unknown; however, 0.7% of geldings and 1.9% of stallions from a survey of more than 700 horses in Canada were reported to be affected (U. A. Leuscher and D. B. McKeown, unpublished data). Some authors point out the similarities of this syndrome to the Tourette's syndrome (TS) of humans. Behavioral parallels between ESMS and TS include head and neck motor tics, hemiballismus (constant, undirected, purposeless striking out with either a forelimb or hindlimb), preoccupation with environmental boundaries, and occasional bizarre vocalizations. Other similarities include juvenile onset, male predilection, familial tendency, an unrelenting course, exacerbation by stress, amelioration by absorbing activities, unimpaired performance, and occasional precipitation by trauma (3).

Animal and human research suggests serotonin (5-HT) dysregulation with SIB. Some evidence to support these findings is the effectiveness of serotonin reuptake blockers to treat these disorders in humans. There is some vague evidence for the role for some of these neurotransmitter systems in ESMS from a clinical survey in which two horses with ESMS reportedly responded to therapy with a dopamine antagonist and a case report describing the suppression of ESMS tics with nalmefine, an opioid antagonist (4). Eight flank-biting horses with ESMS were enrolled for a behavioral study and the effects of drugs that either stimulate or inhibit central opioid, dopamine, norepinephrine, and serotonin neurotransmitter systems were reported. Behaviors were recorded hourly during the study and were compared with those of a saline control baseline to determine whether there were significant differences among the treatments. A significant decrease in ESMS behavior was produced by both morphine and the opioid antagonist, naloxone. Morphine’s effects only became apparent toward the end of the first hour following administration of an “analgesic dose” (0.1 mg/kg) at the 30-minute mark. The suppression of ESMS activities with buspirone suggests a role for serotonergic modulation of the behavior. Buspirone appeared to have 2 to 3 hours of activity at the dosage used in this study (0.5 mg/kg). Based on these findings, the authors believes to support the argument that ESMS resembles human TS. Clomipramine, a preferential serotonin reuptake blocker, did not produce any significant effect on ESMS behavior in the horses in this study. Surprisingly cocaine produced a significant decrease in ESMS behavior in these horses, whereas cocaine may induce tics in humans with TS. However, the authors point out that the actions of cocaine are difficult to identify because it blocks the reuptake of several monoamines, and stimulation of presynaptic receptors for these neurotransmitters may cause decreased motor activity. (5)

ESMS as well as SIB seem to be an equally complex and poorly understood phenomenon. It has been previously suggested to divide equine self-mutilation syndrome based on clinical presentation in 3 types – where Type I represents normal behavioral response to pain or other forms of discomfort. Type II, represents self-directed Inter-male aggression in stallions as well as some geldings and Type III involves a more quiet and repetitive behavioral sequence reminding of stereotypic behavior pattern(6).

The equine practitioner is best served to treat each horse presented with ESMS as an individual case and consider all “Five Freedoms” in the decision making process for treatment. The concept of the “Five Freedoms”, also known as the Brambell Report from 1965, originated with release of Ruth Harrison’s book “Animal machines” in 1964 and was the report of the UK Technical Committee to enquire into the Welfare of Animals. The concept was further refined by the Farm Animal Welfare Council and
eventually released known as the “Five Freedoms”. These principles are relevant measures of welfare and apply to any animal species including horses.

**The “five freedoms”**
- Freedom from hunger and thirst
- Freedom to express normal behaviors
- Freedom from pain, injury and disease
- Freedom from distress and fear
- Freedom from discomfort

**References**
Clinical and theoretical issues in self-injurious behavior; Yaryura-Tobias JA, Mancebo MC, and Neziroglu FA; Rev. Bras. Psiquiatr. vol.21 n.3 São Paulo Sept. 1999, revisão
The goal of this presentation is to identify stressors for the competitive horse, learn how to prepare the competitive horse and how to keep the competitive horse motivated. Some potential stressors for the competitive horse will be discussed such as environmental and dietary stressors, Travel and Transportation stress, Injuries and Illness and training regimen.

**Mind games for competitive horses**

Mentally preparing them for competition, isolation and artificial environments

The goal of this presentation is to:
- Identify stressors for the competitive horse
- Learn how to prepare the competitive horse
- Learn how to keep the competitive horse motivated

What are some potential stressors for the competitive horse?
1. Nature of horses: All change is bad
2. Environmental Stressors: Social interactions (horses, care takers), general daily routine disruptions
3. Dietary variations: Colic, Gastric ulcers, weight loss
4. Travel/Transportation
5. Injuries/Illness
6. Training regimen

**1. Nature of horses: All change is bad**

- How about stress in natural settings, do they exist?
  - Horses are prey animals → equipped to deal with stress
  - Adapting behavior keeps them safe in nature
  - Behavior has to be adapted quickly all the time: "Fight or Flight" response
- How does the body handle stress? What happens in the "Flight and Fight" response?
  - Stress activates the autonomic NS, which leads to a sympathetic response in the body: Adrenal gland stimulated, HR increases, Pupils dilated, this has an effects on many organ systems.
- How is this response helpful?
  - Increase in heart rate, blood pressure and respiration: Pumping more blood and oxygen to the important muscles
  - Increased blood glucose: Rapid energy
  - Pupils dilate: Sharpening of senses
  - Prioritizing: Increased blood supply to peripheral muscles and heart, and brain; decreased blood supply to digestive system
  - Secretion of Adrenaline and other stress hormones: Further increases this response
  - Secretion of endorphins: Natural painkillers, providing an instant defense against pain.

Stress also manifests in behavior problems: Resistance, aggression, fear, anxiety, stereotypic behaviors. Chronic Stress and distress leads to compromised welfare, maladaptive behaviors and behavior changes: physical and/or psychological.

Which Horses become good competition horses? Nature and Nurture

**2. Environmental stressors: New environment: Smells, noises, visual trigger, size of confinement, change in exercise surfaces, new Social structures**

- How to prepare the horse?
  - Getting horses used to many different situations, housing types, footing types and others early on; horses that habituate quickly are better equipped and more relaxed!
- How to prevent problems? Allow time to adapt/habituate when in any new environment, bring familiar visual or olfactory cues from home, be aware of your horses social needs, bring a friend (social facilitation).
  - If everything else changes, the human needs to be consistent!
3. Dietary variations and stress leads to dehydration, colic, gastric ulcers and chronic weight loss
How to prevent dietary stress: maintain feeding schedule and routine, feed high quality feed, increase roughage, allow regular grazing and foraging, use feed dispensing toy’s and enrichment

4. Transportation stress:
The horse on the move is exposed to nearly every recognized potential stressor factor as well as respiratory infections and gastric ulcers. Studies have suggested that loading and unloading are considered most stressful. The stress response decreases with repeated transportation, suggesting habituation. Driving to a destination entails not a continuous constant stressor, coping with changes in speed, road surface, and turns will require some form of physical fitness from the horse.

- How to prevent transportation stress: Start early, use classical conditioning and positive reinforcement, social facilitation, gradual introduction, load on regular basis, so it becomes routine, always take your time for loading and unloading-don’t rush!
- How to prepare? Always keep the trailer in good working order, Trailer in a safe location - Footing, other distractions, load on regular basis, so it becomes routine start early: Take your time-don’t rush!
- Traveling problems arise: Fear, Balance problems, Footing, Trailer comfort, Suspension, Social interactions, Direction of travel, Length of travel

5. Injuries/illness: Competition horses are athletes, they are at higher risk for injury and illness. Is the horse ready?
How to prevent and prepare? Regular Vet checks, Vaccinations, DW, Tack checks, Hoof care, Dental care, Nutritional demands, TLC, Nutraceuticals, Cross training, appropriate rest periods

6. Training regimen
Training is most rapid and consistent when training related stress is minimized and when training practices match a horse’s mental and physical abilities. A good trainer has realistic expectations for the horse, is aware of physical and mental limitations that could affect the quality of training outcome and picks the right horse for the job to minimize training stress. The training methods used have to be positive – training has to be rewarding and motivating. Punishment and harsh methods lead to conflict and learned helplessness. To maintain motivation, work sessions should be short, breaks in session should be appropriate, new skills should be practiced while old ones should be mastered, training should be based on command – response - reward approach, and it is important that all session end on a good note, cross training should be implemented in all disciplines.
Understanding of equine behavior and learning is the main objective of this presentation. In this presentation we will discuss what it means to handle a “spoiled” horse. How it can easily happen and how to prevent it from happening. We also want to address how to change unwanted behaviors.

Horses are powerful animals and with just a quick move of their 100 pound head, or a kick with their strong legs, they can not only seriously injure the handler, but in addition, place bystanders and the horse itself at risk. It is very important to maintain safe and gentle handling techniques while dealing with a difficult or “spoiled” horses. It is even more important to learn how to keep a horse in a mental and physical state so it does not become difficult or “spoiled” in the first place. This can be achieved by properly understand and apply learning theory to training, starting at day one. Horses are gregarious and have all their senses ready to learn from the very first hours of their lives.

Earliest archaeological evidence of the domesticated horse goes back to 4000 BC, and even though that seems like an awful long time ago, we need to keep in mind that cave paintings from about 15,000 years ago prove that humans hunted the horse for food and hides much longer than we’ve been riding this majestic animal. The horse evolved as a social herbivore that relies mainly on caution, speed and agility for self-preservation, and is dependent on companions for safety, mutual comfort and grooming, and enhanced detection of food. To ensure safe and enjoyable interactions with our horses we need to understand their deeply ingrained need to feel safe. Any small change can cause the horse to go into a physiological fear response—the sympathetic nervous system’s fight-or-flight response. All behaviors following this trigger point are geared to decrease the real or perceived threat. The goal should always be to keep any horse relaxed. In this emotional state, the horse can learn and focus on cues and aids.

Knowledge in equine behavior, medicine and learning theory are needed develop a well-mannered horse and to handle the difficult horse in order to make it manageable. We all want the best for our horses. We want them to succeed or even more so we want to succeed with them. When holding on to one end of a rope with a horse attached to the other end, a handler has to be aware that he/she is constantly teaching that horse new skills and behaviors, both intended and unintended. You might have noticed that some handlers seem more successful at handling horses than others. While not denying that some horses are more difficult to handle than others, it seems that some handlers tend to end up fighting with their horse more often than others. This lecture is written with the intent of helping any horse enthusiast and any professional handler improve their handling skills by helping them understand the different development stages so you can set up your horse for success.

Most horses are quick learners and will do almost anything you ask them to if you can present it to them while they are in an emotionally receptive state. This allows for much smoother and safer handling. This will not only improve your safety and the safety of those around you, but it will also increase the pleasure of working with horses. Resistance always creates tension in you and your horse, which will ultimately lead to physical or psychological problems.

Learning in horses
Learning is crucial for survival and behaviors need to be continuously adapted. Changes in the environment function as stimuli and the animal reacts with a physiological or psychological response. Learning is a relative stable change in behavior based on experiences. Emotions play a crucial role in memory; negative experiences can have long lasting effects.

Non-associative learning
This is a “single event learning”, where the animal is exposed to only one stimulus and the animal decreases its response toward the stimulus over time (Habituation) or increases the response over time (Sensitization). Leading to adaptation to a repeated stimulus.

Decrease in response to the stimulus: Habituation (getting used to it): the animal does not react to the stimulus any longer.

Simplest form of learning. Example over time the horse habituates to the feeling of a halter or a saddle.

This can be achieved with 2 different processes
1. Flooding: The animal is exposed to the stimulus above the threshold of reacting to it and is exposed until habituation has occurred. It is important to not let the animal escape the stimulus. This can be a dangerous process as there is not much control how the animal will react to the stimulus once exposed. It is crucial to not stop to expose the animal to the stimulus until it has habituated.
2. Desensitizing: the animal is exposed to the stimulus in small increments and exposure is slowly increased after the animal has gotten used to or has habituated to the lower level of exposure. This process is gradual and the animal is exposed below or just at the threshold of reacting to the stimulus. There is much more control over the process by the handler with this type of exposure and is therefore the safer option for habituation in many circumstances.
Increase in response to the stimulus: Sensibilization (getting more sensitive) is the opposite of habituation where the reaction increases with the same amount of exposure to the stimulus. Example a painful area that elicits a withdrawal response BEFORE someone touches the area.

**Associative learning**
In this type of learning there will be an association made between two or more stimuli.

There are two different ways of conditioning described both of them crucial to learning:

**Classical, or Pavlovian conditioning**
In classical conditioning a conditioned stimulus (CS) is paired with an unconditioned stimulus (US). The conditioned stimulus (CS) is a neutral stimulus (e.g., the sound of a clicker), the unconditioned stimulus (US) is biological response (e.g., the taste of a treat). The unconditioned response (UR) to the unconditioned stimulus is an unlearned reflex response (e.g., salivation). Over time after pairing of the CS with the US is repeated, the animal will display a conditioned response (CR) to the conditioned stimulus CS when the conditioned stimulus is presented alone.

**Operant, or instrumental conditioning (E. Thorndike and PF Skinner)**
In operant conditioning the behavior is modified by its consequences.

The 5 basic concepts include

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**Positive reinforcement**
Leading to the likelihood that a behavior *increases* in frequency and this happens if the behavior is immediately followed by a *rewarding* stimulus – think money!

**Negative reinforcement**
Leading to the likelihood that a behavior *increases* in frequency due to the removal of an *aversive* stimulus – think beeping of your seatbelt!

**Positive punishment**
Leading to the likelihood that a behavior *decreases* in frequency and it happens if the behavior is immediately followed by an *aversive/punishing* stimulus – think speeding ticket!

**Negative punishment**
Leading to the likelihood that a behavior *decreases* in frequency due to the removal of a *rewarding* stimulus – think timeout!

**Extinction**
Occurs when a behavior (response) that had previously been reinforced is no longer effective. For example, a horse is pawing at the arrival of the food truck. Then, during "extinction", no food is given. Typically the horse continues to paw more and more slowly and eventually stops, at which time the behavior is said to be "extinguished." Often time they will try harder first before they give up, called an extinction burst and can lead to certain frustration behaviors initially – think no coke is coming out of the coke machine after putting your money in!

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**Further reading**
- Paul McGreevy and McLean: Equine Behavior; Equitation Science; Carrots and Sticks, 1st edition, 2010, Blackwell Publishing
Asking the Right Questions: 
Taking a Behavior History
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The goal of this presentation is to improve history taking skills which are necessary for examination and creating a behavior problem list. Communication skills as well as knowledge about how and what to ask during an appointment are discussed. Specific questions vary depending on what type of problem will be addressed; however, the general framework provided in this presentation will allow a clinician to create a complete behavior problem list.

History taking
Taking a history from a client is a necessary skill for any practicing veterinarian, whether you are a specialist, or not. Specifically within behavioral medicine, compiling a complete history and detailing the results of behavioral observations are the main aspects for reaching a conclusion. Hence, a large portion of any behavior appointment is dedicated to getting the complete history. A good history will allow the practitioner to identify all the problems, continue on the path to create a list of differentials, which will eventually lead to the road that takes the clinician to the destination – the diagnosis, hopefully. History taking skills require communication skills as well as knowledge about what to ask and how to ask it. Not only, but especially within behavior medicine, asking the right question or asking the question in the right way will help tremendously in reaching a diagnosis, because fancy diagnostic tests are not (yet) available to the veterinary behaviorist. Most veterinary behaviorists require the clients to fill out a lengthy history form (example: https://www.sfspca.org/behavior-training/behavior-consultations) and will review them prior to meeting with the client and the patient to save on appointment time. This process also helps greatly for asking specific questions in order to arrive at a diagnosis more efficiently. The goal of this presentation is to lead the practitioner to the path of a behavior diagnosis with the treatment as an outcome goal.

A: Opening
Introduce yourself. Chances are the client knows who they are coming to see; however, it is good “bed-side manners” to introduce yourself first and explain to the client how the appointment will be structured. You are setting the expectations from the start.

Signalment: Identify your patient: age, breed, and weight are important data and can affect your differentials, diagnosis and/or your prognosis.

B: Exploration

Presenting complaint (PC)
This is what the client tells you is wrong with the patient.

History of presenting complaint (HPC)
Gain as much information you can about the specific complaint(s).
1. Determine trigger(s) that elicit the behavior(s): try to be as specific as possible, (e.g. a large male wearing a hat and carrying a garbage bag coming from the front)
2. Determine the threshold: at what level does the behavior NOT occur? This is just as important as at what level the behavior does occur. Clients will often tell you the behavior happens “all the time” or “unpredictably”; it is your job to ask the questions to determine the situations or circumstances as to when the behavior does or does not occur. Open ended questions are preferred in the beginning stages of an interview as not to “lead” the client.
3. Body language: the description of the body language before, during, and after the behavior problem occurs is very important. This information can be provided by verbal description from the client, observation of a video and/or pictures as well as by direct observation. However, aggressive incidents do not need to be “reenacted”. In most cases it would be unsafe and irresponsible to do so and it is not needed in order to develop a problem list or a list of differentials.

Past medical history (PMH)
Gather information about the patients other medical problems (if any) and vaccine history. Past or concurrent medical problems can directly affect your problem list, differentials and diagnosis.

Drug history (DH)
Find out what medications the patient had been taking in the past or is currently taking, including dosage and how often they are taking them e.g. once-a-day, twice-a-day, etc. including any OTC, herbal, homeopathic or other products which have or have not worked for the patient. Past or concurrent medications can directly affect your differentials and your treatment plan.

Find out if the patient has any food restrictions or other allergies.

Family history (FH)
Gather some information about the patients and the family’s daily routine such as feeding schedule, sleeping location, exercise.
Training history (TH)
This is the opportunity to find out a bit more about the patient’s training background. What commands and tricks can the patient do and what training methods were used to train. The use of confrontational techniques used in the past can directly affect your differentials and diagnosis.

C. Summary of history
Complete your history by reviewing what the client has told you. Repeat back the important points which lead you to creating your problem list, so that the client can correct you if there are any misunderstandings or item missing. This does not mean that you will be addressing each and every problem in your initial appointment but it does allow you to discuss priorities of the problems. Often the priorities of the client and the priorities of the severity of the problems are not the same and the client needs to be educated. By summarizing the important points you will be able to find any discrepancies and will avoid non-compliance, or even frustration.

Review the client’s goals and expectations for the consultation. It is often a good idea to ask what the precipitating event for this consultation is. Many problems have been ongoing for years and a change in environment, routine or social events might elicit the consult with specific needs for the client. A good acronym for this is ICE - Ideas, Concerns and Expectations.

Patient questions/feedback
During or after taking the history, encourage the client to ask any questions they may have.

D. Closing
When you are satisfied that you have all of the information you require in order to complete your problem list and reach a diagnosis, you will summarize your assessment and explain your diagnosis. You will discuss the steps of the treatment plan. You must consider the safety issues and recognize the client’s limitations (emotional, environmental, financial, time restrictions, other family member’s views). Client’s compliance, or lack thereof, should be acknowledged and understood, otherwise might lead to frustration of everybody involved. A client that fully understands all aspects of the treatment plan has increased chances for compliance. You need to set expectations and a schedule for any required recheck visits. Thank the client for their time and encourage them to follow up with you with any questions or concerns. I tell my clients that I assume “No news is good news”!
How I Treat About Anything: 
Behavior Treatment Plan

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This presentation offers general practitioners a quickly reference for the treatment for any patient with behavioral problems. We will discuss the 5 steps needed for a complete behavioral treatment plan employed by specialist for any behavior problem.

Behavior treatment plan
The treatment of any behavioral problem includes a multi-facetted approach consisting of a 5-Step process. You might chose to implement some, or all of the 5 steps involved depending on the case, the circumstances, and your level of skills; however, any veterinarian should be able to recommend steps 1 and 2. An example of a generic discharge or treatment template for any behavior diagnosis could look as follows:

1. Management: Safety and avoidance
In order to set up the patient for success, strict management is needed at the beginning of every plan. Initially, the owner will have to set the stage and manage the pet’s environment so as to avoid any situations in which the pet has displayed the unwanted behavior in the past. Initially, the treatment process can be slow; hence, in the meantime, the owner must prevent those events from reoccurring. Every time a pet displays this behavior, the behavior is further rehearsed and this might be inadvertently reinforcing the behavior problem you try to treat. Therefore, as you are in the process of treating, the patient should not be exposed to the trigger(s) which cause the unwanted or unacceptable behavior(s). The owner should begin by mentally taking note of all situations where the pet displays the(s) behavior(s). In addition to supporting the overall success of the behavior modification, avoidance may also be a safety recommendation in some cases.

2. Structuring the relationship with the pet and strengthening the human-animal-bond 
Aware – affirm – award approach
There are many advantages to using such a program as part of a training program for a pet. First, it is a program that fits all pets and all people, regardless of breed, age, size, gender or personality-type. It is a non-confrontational technique which is designed to never put the people or pets involved at risk. It will help to teach pets how to be better prepared to live within human society. It will help improve behavior and teach the pet to learn to trust people due to the predictable interactions with positive outcomes. The pet will learn to consistently follow commands at home or other low stress situations which makes it easier for him/her to follow commands in potentially challenging situations such as when distracted, anxious or perhaps even while aggressive. Finally, it will help build confidence by providing clear communication and enjoyable outcomes for desired behaviors. This approach uses only positive, reward-based training methods to teach these valuable lessons. The program consists of 2 principles.
   1. Predictable interactions with the pet based in Command – Response – Reward (C-R-R)
   2. Awareness of the good/desired behaviors that will be affirmed (marked) and awarded

3. Tools
This is any equipment that will help with the implementation of the management plan and the reward-based training program. Specific recommendations should be provided to the client. The list is endless, but could include items such as baby gates, kennels, crates, screen doors, window covers, leashes, tethers, head halters, front buckle harness, basket muzzle, clicker, target stick, MannersMinder, treat pouch, treats, relaxation mat, feed dispensing toys and puzzles, interactive toys, Relaxation music (Thru the dogs ear), visual entertainment (DOGTV), litterboxes and litter type, nail caps for cats, scratching posts and many more.
   NOTE: My list does NOT include anti-bark devices, shock collars, prong collars, shaker cans, throw chains and other pain and fear eliciting items – tools that help suppress behaviors rather than help teaching new positive behaviors and emotions can lead to increased fear, anxiety and aggression.
   http://avsabonline.org/resources/position-statements
   https://vet.osu.edu/assets/pdf/hospital/behavior/trainingArticle.pdf

4. Reintroduction: Positive emotional response and incompatible behaviors
First, the animal has to be prepared for the reintroduction to the triggers or situations that have to be avoided initially (see Step 1, 2 and 3). The positive emotional response and behaviors that will be practiced and rewarded should be simple and incompatible with the unwanted behavior. (Example: sitting quietly is a positive behavior that is incompatible with lunging). Thus, the pet associates the low level of negative stimulus with the positive reward for a relaxed state and behavior. The pet will gradually learn to associate good
things happening and have a positive response. The Command – Response – Reward (C-R-R) approach helps the dog to perform trained commands reliably in various types of situations and therefore the pet can then be reintroduced to previously challenging situations in a step by step process, where the unwanted behavior is never displayed – this is called desensitizing and counter-conditioning (DS/CC). It is a technique that all people, regardless of age, size, or personality-type can do. It is a non-confrontational technique which is designed to never put the people or dogs involved at risk. Finally, it will help build a dog’s confidence by providing clear rules and enjoyable outcomes for good behavior. Having a pet consistently follow commands at home, in low stress situations, makes it easier for him/her to follow commands when distracted, anxious or perhaps even while aggressive. The program also acknowledges the animal consistently with a marker and reward when performing any behaviors that are incompatible with the unwanted behavior without a prior cue.

Give the client Homework and be specific. Ensure that the client understands the exercises, this will enhance owner’s compliance and overall success of the treatment plan.

The stimulus that was identified during the appointment as causing the pet’s unwanted emotional reaction and subsequent problem behaviors will then be reintroduced in a series of gradual steps/intensities. The common gradients that are used for DS/CC are altering the intensity and changing the distance to the stimulus. The intensity can be changed by altering the location, loudness, speed of movement, duration, types of stimuli, or components and response of the stimulus. DS/CC needs to start at the lowest intensity that results in no signs of anxiety or concern. The stimulus (at the lowest intensity and/or at the furthest distance) is presented and the pet is rewarded for the new, relaxed attitude and behaviors. The stimulus is repeated over multiple sessions, while the pet is rewarded for the positive behavior. Every session should be brief and always end by rewarding the display of positive behavior(s).

Key points
DS/CC takes time and requires that the process be gradual. Since progress is often slow, maintaining a journal of the behavior to track the progress is helpful. Problems usually arise from progressing too quickly and not taking small, incremental steps. Don’t progress faster than what the pet can accept. It is also vital that every positive behavior be rewarded and that the reward is truly rewarding to your dog. Each step will need to be planned out and it is important to have all tools needed ready before starting each DS/CC session. Remember, since the problem behavior took time to develop, to look for small, incremental improvements rather than instant results.

5. Medications
Medications can be part of the treatment of behavior problems. Medications should only be used with a concomitant diagnosis and preferably full laboratory testing (CBC, Chem and T4, UA, Urine culture). It can help lower the anxiety level, so that the behavior modification can be more effective. It is not a cure for the problem, nor should medications be used without concurrent behavior modification plan. Most medications are “off label” use and the client needs to be informed about the potential side effects and adverse effects with any other medication(s).
Nuisance behaviors—jumping, stealing things, trash diving, charging through the door, begging, and all the other things dogs do that drive us crazy—are deeply frustrating and can eat into the enjoyment of sharing your life with a dog. The good news is that nuisance behaviors are also easily preventable. Once we move away from the myths that every behavior is motivated by the dogs bidding for dominance, and understand what truly motivates the dog to behave the way he does, we can use this motivation to train any alternate behavior we prefer. In this presentation we discuss training solutions to train/reward opposite or competing behaviors.

Rambunctious, jumpy, mouthy dogs: The quick fix for RJM dogs

So many of our dog’s behaviors are normal and have evolved because of their close relationship to humans. Nonetheless, some of these behaviors can be annoying to the point of breaking the human-animal bond. It can be difficult to see how to change your course of action to get back on track with the dog. In this presentation we will discuss how to address basic issues of some common nuisance behaviors seen every day in practice (for example jumping, stealing and pulling on leash). Emphasis is placed on properly understanding and applying learning theory to improve your communication and training skills.

Nuisance behaviors—jumping, stealing things, trash diving, charging through the door, begging, and all the other things dogs can be deeply frustrating and can eat into the enjoyment of sharing our life with a dog. The good news is that nuisance behaviors are also utterly preventable and easy to fix. Once we move out of the realm of myths, like dominance, and understand what truly motivates the dog to behave the way he does, we can use this motivation to train an alternate behavior we prefer.

Jumping up, for example, is not based in dominance but normal canine greeting behavior. Most dogs are happy to see their owners and have no idea how they would prefer to be greeted. Most of the time the jumping behavior has been inadvertently and intermittently rewarded and hence strengthened the jumping over time. Owners have to understand that what is perceived as punishment, such as pushing or scolding, rarely works because attention is still given and attention is precisely what the jumping dog wants. So how are behaviors such as jumping up while being greeting decreased if we don’t want to punish, which might inadvertently break the human-animal bond or have other unintended consequences? We want the dog to be happy to see us, but we don’t want the jumping. First, we have to understand that dogs have evolved a greeting ritual specifically to interact with humans. They use this ritualized “I’m happy to be meeting a familiar human” greeting to communicate varying degrees of recognition and attachment.

Mouthiness and chewing are other examples of misunderstood canine behaviors that have evolved for good reasons. Dogs have evolved using their mouth and teeth to gain access to most desirable things; chewing begins in the first few weeks of puppyhood and never stops. Food may be served once or twice a day in a bowl now, but the chewing needs still strongly exists, especially in some dogs. Initially all items in a home are fair game to a puppy, until the dog has learned to understand what is acceptable chew material to the human and what isn’t.

In order to change unwanted nuisance behavior (keep in mind they are only nuisances to us, for the dog they are perfectly fine and strongly motivated behaviors— greeting, jumping, chewing) we need to understand canine motivation and learning theory. Instead of seeking to decrease these behaviors using punishment, a much preferred approach is to focus on helping our dogs learn what we would like them to do instead. For example very simply: greeting us by sitting.

How do we fix RJM?

Management first

In order to set up the dog for success, strict management is needed in the beginning. Initially, the owner will have to set the stage and manage the pet’s environment so that the behaviors that we attempt to decrease do not get rehearsed and inadvertently, or intermittently reinforced. Managing includes having the tools and equipment ready that will help with the implementation of the management plan and the reward based training program. The list is endless, but could include items such as baby gates, kennels, crates, screen doors, window covers, leashes, tethers, head halters, front buckle harness, basket muzzle, clicker, target stick, MannersMinder, treat pouch, treats, relaxation mat, feed dispensing toys and puzzles, interactive toys, Relaxation music (Thru the dogs ear), visual entertainment (DOGTV), and many more.

NOTE: My list does NOT include anti-bark devices, shock collars, prong collars, shaker cans, throw chains and other pain and fear eliciting items – tools that help suppress behaviors rather than help teaching new positive behaviors and emotions can lead to increased fear, anxiety and aggression.

http://avsabonline.org/resources/position-statements
https://vet.osu.edu/assets/pdf/hospital/behavior/trainingArticle.pdf

Rambunctious, Jumpy, Mouthy Dogs: The Quick Fix for RJM Dogs
Jeanine Berger, DVM, DACVB, DACAW, CAWA
San Francisco SPCA
San Francisco, CA

Nuisance behaviors—jumping, stealing things, trash diving, charging through the door, begging, and all the other things dogs do that drive us crazy—are deeply frustrating and can eat into the enjoyment of sharing your life with a dog. The good news is that nuisance behaviors are also easily preventable. Once we move away from the myths that every behavior is motivated by the dogs bidding for dominance, and understand what truly motivates the dog to behave the way he does, we can use this motivation to train any alternate behavior we prefer. In this presentation we discuss training solutions to train/reward opposite or competing behaviors.

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http://avsabonline.org/resources/position-statements
https://vet.osu.edu/assets/pdf/hospital/behavior/trainingArticle.pdf
Management plan examples
To avoid: Manage:
Jumping on visitors at the door Put the dog in another room before they arrive
Jumping on you when entering Place a baby gate to deny direct access to the front door
Barking at passers-by outside Draw the curtains or restrict the dog’s access to the front window
Pulling on leash Use an anti-pull head halter or harness
Attacking the water hose Put the dog inside while watering your plants
Chewing on furniture Do not allow access – use a baby gate or crate

Structuring the relationship with the pet and strengthening the human-animal-bond
Aware – affirm – award approach
There are many advantages to using this program as part of a training program for any pet. First, it is a program that fits all pets and all people, regardless of breed, age, size, gender or personality-type. It is a non-confrontational technique which is designed to never put the people or pets involved at risk. It will help to teach pets how to be better prepared to live within human society. It will help improve behavior(s) and teach the pet to learn to trust and understand people due to the predictable interactions with positive outcomes. The pet will learn to consistently follow commands at home or other low stress situations which makes it easier for him/her to follow commands in potentially challenging situations such as when guests are at the door when stranger pass by the home. Finally, it will help build confidence by providing clear communication and enjoyable outcomes for desired behaviors. This approach uses only positive, reward-based training methods to teach these valuable lessons. The program consists of 2 principles.

1. Predictable interactions with the pet based in Command – Response – Reward (C-R-R)
2. Awareness of the good/desired behaviors that will be affirmed (marked) and awarded

Training plan examples
To replace: Train:
Jumping on visitors at the door Sit on a mat next to the door before the door opened
Jumping on you when entering Always mark and reward when he approaches and stands or sits
Barking at passers-by outside Go get your favorite toy
Attacking the water hose Fetch or hide-and-seek with dog toys
Chewing on furniture Go get your favorite toy

Note the difference between managing and training the unwanted behaviors. Managing is NOT training, but nonetheless important for setting the dog up for success.

Physical and mental stimulation
Physical exercise is fundamental and should be age appropriate.

Mental stimulation is just as crucial as physical exercise and can be implanted for a dog of any size, breed, and age and includes anything from working for food, to using food puzzles and other interesting games that engage a dog’s brain and learning tricks or commands in a different language. Dogs are natural hunters and problem solvers, so the closer we can mimic this process, the less troublesome the dog will be to live with. Serving all the dog’s meals in a stuffed Kong or treat ball, in a food-dispensing device, or through a game such as hide-and-seek or busy box toys can relieve many nuisance behaviors quickly.

Helpful hints
1. Remove all rewards/reinforcement for nuisance behaviors, i.e. ignore the dog completely and instead praise and treat the dog for sitting, being quiet, chewing on his toys, etc.
2. Be consistent. If jumping up on people is allowed some days and not on others, the dog won’t understand that the rules change during the week.
3. Be persistent. After repeated reinforcement (however unintended) of a nuisance behavior, the dog won’t immediately abandon his original strategy, he might even try harder first before he gives it up. This is called an extinction burst.
4. Appreciate your dog’s cleverness; some things can easily be ignored, not every unwanted behavior needs immediate intervention. Sometimes not making a big deal out of something is already enough to decrease the behavior. Get off the couch and play with your dog when he gets the old slipper you were ready to toss out anyways, if you don’t he will get your expensive Italian leather shoes and that will make you jump off the couch very fast in turn you have just taught your dog that he should not bother with the slippers (or his own toys for that matter) but go directly to those yummy smelling soft leather shoes!

Some important terms from learning theory
Motivation
This is the force that drives all behaviors. Food, treats, attention, praise, toys, play, walks, coming along for a car ride, etc. – these can be used to reward the behaviors we like, we give them anyways it is just a questions of timing when we dish it out – when they jump or when they sit?
Good news; no need to assert our dominance during training. It has been established for many thousands of years now that *Homo sapiens sapiens* is the dominant species and dogs don’t challenge us for that position. We already control all the resources and we can now, once and for all, move on. The notion of dominance in dog training, commonly interpreted as a dog wanting to be the alpha of the pack and thus acting aggressively or assertively in some way, has been thoroughly and successfully debunked by research. Furthermore, it has been shown that implementing training techniques that employ such antiquated dominance training theory methods increase aggression.

**Positive reinforcement**

Any stimulus that is added after a behavior occurs that increases the likelihood of that behavior happening again.

**Intermittent reinforcement**

Rewarding a behavior only sometimes. Think Las-Vegas gambling effect. Intermittent reinforcement is a powerfully motivating force to all animals, including humans.

**Positive punishment**

Any aversive or painful stimulus that is added after a behavior occurs that decreases the likelihood of that behavior happening again.

**Attention seeking/getting behaviors**

Social creatures like dogs do many things to get and hold our attention. They might jump on us, paw, or steal the Italian leather shoe—obviously a high-value object guaranteed to get attention. The good news is, any dog that is highly motivated by interactions with us is in general easy to train.
Nonverbal communication is fascinating to most humans, especially to animal lovers. Body language, behavior, and vocalizations are key elements to understanding our feline friends, patients and shelter animals. Just as we have to improve our knowledge to communicate with each other, we should place effort on learning to use a feline dictionary, similarly to learning any foreign language. Such a feline dictionary should include 3 chapters including 1. Vocalization; 2. Facial expressions, and 3. Body language. Failure to read these signals correctly can lead to injury to human handlers, break in human-animal bond, and decrease in animal welfare.

**Feline dictionary: Understanding feline body language**

Nonverbal communication is fascinating to most humans, especially to animal lovers. Humans rely heavily on verbal communication, but misunderstandings between us happen at times. In fact, we are much better prepared to read body language than one might think. Interestingly, modern scientists cannot agree when vocal language first appeared, the range spans anywhere between 100,000 to 200,000 years ago. This might be the reason that important emotions and intentions are processed by the limbic system and expressed through body language. There are recent studies which show that the expression of such feelings in humans is universal. If we are at times unsure about interpreting our own species body language, how much more difficult might it be to understand the body language of a different species such as our feline friends? We attempt to translate facial expression, body postures, tail position and many other small details into human understandable signals. It should be no surprise that this can easily fail. Failure to read these signals correctly can lead to injury to human handlers, break in human-animal bond, and decrease in animal welfare.

Compared to dogs, cats are not as obviously vocal. However, certain cats are more vocal than others and cats can learn to use vocalization to communicate with humans. Body language, behavior, and vocalizations are key elements to understanding our feline friends, patients and shelter animals. Just as we have to improve our knowledge to communicate with each other, we should place effort on learning to use a feline dictionary, similarly to learning any foreign language. Indicators such as the look in your cat's eyes, the tone of her vocalization, the position of her ears, and the motion of her tail can provide important clues that reveal certain intentions. You can learn to "read" these signals to get a better idea of what's on your cat's mind. Such a feline dictionary should include 3 chapters including 1. Vocalization; 2. Facial expressions, and 3. Body language. However, keep in mind that no feline language can be completely interpreted without taking into account the entire body language and the situation and surroundings the cat is in.

**Chapter 1: Vocalization**

Many different feline vocalizations exist and experts have tried to describe the repertoire, a daunting task when trying to classify the different acoustic variations. Most cat owners know when to give their cat attention or when it is time to feed her (at least in the cat’s opinion). Most people can tell when a cat is happy and most veterinarians have heard a really distraught cat – those emotions are differentiated by the different tones and noises the cat makes. The following tables are adapted from “Domestic Animal Behavior” Chapter 1 and do not claim to be complete. The presenter recommends consulting the recommended reading list for further details.

<table>
<thead>
<tr>
<th>Vocalization</th>
<th>Phonetics</th>
<th>Translation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Murmur</td>
<td>Soft, rhythmical pulsed given on exhalation</td>
<td>Request or greeting</td>
</tr>
<tr>
<td>Meow</td>
<td>Characteristic feline call “mee-ah-oo”</td>
<td>An all-purpose greeting, epimeletic situations</td>
</tr>
<tr>
<td>Purr</td>
<td>Soft, buzzing, rapid contractions of the muscle of the larynx</td>
<td>Social situations, sign of contentment, may also purr when he's anxious or sick</td>
</tr>
<tr>
<td>Growl, hiss and spit</td>
<td>Harsh, low pitched, open mouth, explosive sound</td>
<td>Agonistic, defensive, frightened, stressed or aggressive. Leave this cat alone!</td>
</tr>
<tr>
<td>Squeak</td>
<td>High pitched, raspy cry</td>
<td>Play, feeding, female after copulation</td>
</tr>
<tr>
<td>Shriek</td>
<td>Loud, Harsh, high pitched</td>
<td>Intensive aggressive or painful – stop - what you are doing is not working for the cat</td>
</tr>
<tr>
<td>Chatter</td>
<td>Teeth chattering</td>
<td>Hunting sound or when restrained from hunting</td>
</tr>
<tr>
<td>Estrus call</td>
<td>Long lasting, variable pitch, open mouth then gradually close</td>
<td>Female in estrus</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>-----------------------------------------------------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>Howl and Yowl</td>
<td>Loud harsh drawn out calls</td>
<td>Aggressive, distress. Elderly cats with cognitive disorder</td>
</tr>
<tr>
<td>Mowl or catercall</td>
<td>Variable pitch call</td>
<td>Male sexual</td>
</tr>
<tr>
<td>Mew</td>
<td>High pitched, medium amplitude, long “eee”</td>
<td>Mother – kitten interactions</td>
</tr>
<tr>
<td>Moan</td>
<td>Low frequency, long duration “oo” or “uu”</td>
<td>Epimeletic, or before coughing up a hairball</td>
</tr>
</tbody>
</table>

**Chapter 2: Facial expression**

<table>
<thead>
<tr>
<th>Facial part</th>
<th>Expression</th>
<th>Translation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eyes</td>
<td>Pupils constricted</td>
<td>Content, offensively aggressive</td>
</tr>
<tr>
<td></td>
<td>Pupils dilated</td>
<td>Nervous, submissive (somewhat dilated); defensively aggressive (fully dilated); playful, aroused</td>
</tr>
<tr>
<td>Ears</td>
<td>Forward</td>
<td>Alert, interested, happy, relaxed</td>
</tr>
<tr>
<td></td>
<td>Erect, swiveled, opening point to the side</td>
<td>Irritable, stressed, aggressive</td>
</tr>
<tr>
<td></td>
<td>Flat, backward, sideways</td>
<td>Fearful, frightened, irritable, stressed</td>
</tr>
<tr>
<td></td>
<td>Swiveling</td>
<td>Attentive, listening to every little sound, alert</td>
</tr>
<tr>
<td>Mouth</td>
<td>Closed</td>
<td>Relaxed</td>
</tr>
<tr>
<td></td>
<td>Open tight and showing teeth; wide open with hissing or spiting</td>
<td>Fearful, aggressive</td>
</tr>
<tr>
<td></td>
<td>Gape, flehmen: Head lifted, mouth open slightly, tongue is flicking, lips curled back slightly, eyes squinting</td>
<td>Strange smell</td>
</tr>
</tbody>
</table>

**Chapter 3: Body posture**

<table>
<thead>
<tr>
<th>Body part</th>
<th>Expression</th>
<th>Translation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body</td>
<td>Back arched, fur standing on end (Halloween cat)</td>
<td>Very frightened and defensive aggressive</td>
</tr>
<tr>
<td></td>
<td>Back arched, fur flat</td>
<td>Welcoming your touch</td>
</tr>
<tr>
<td></td>
<td>Lying on back, purring</td>
<td>Relaxed, may be asking for a tummy rub, or it may be a “Venus fly trap”</td>
</tr>
<tr>
<td></td>
<td>Lying on back, growling, upset</td>
<td>Ready to strike with teeth and claws</td>
</tr>
<tr>
<td>Head</td>
<td>High</td>
<td>Neutral, confident, happy, aggressive</td>
</tr>
<tr>
<td></td>
<td>Low or backwards</td>
<td>Fearful, submissive</td>
</tr>
<tr>
<td>Tail</td>
<td>Erect, fur flat</td>
<td>Alert, inquisitive, happy</td>
</tr>
<tr>
<td></td>
<td>Horizontal</td>
<td>Relaxed or unsure</td>
</tr>
<tr>
<td></td>
<td>Straight up, quivering</td>
<td>Excited, really happy, ready to urine mark</td>
</tr>
<tr>
<td></td>
<td>Straight up, tense, fur standing on end</td>
<td>Angry, frightened, fearful</td>
</tr>
<tr>
<td></td>
<td>Held very low or tucked between legs</td>
<td>Insecure, anxious, fearful</td>
</tr>
<tr>
<td></td>
<td>Thrashing back and forth</td>
<td>Agitated, watch out!</td>
</tr>
</tbody>
</table>
Distance increasing signs are signals that tell us it is safe to approach and interact

When the cat is happy and content, she is sitting or lying down, has the eyes half-closed and her pupils are narrow. The tail is mostly still, the ears relaxed and forward and the cat could be purring.

The cat is playful when her ears are forward, the tail is up, the whiskers are directed forward and the pupils somewhat dilated, usually seen in young cats. Of course different forms of play exist such as object play, social play or predatory play.

When your cat rubs her chin and body against you, she is telling you she is comfortable with you, because she wants to exchange scent, similarly rubbing the couch and other things in the home. It is a sign of comfort or marking the territory.

The cat is kneading when she uses both paws with a massage like motion mostly on a soft surface, some people call it "making biscuits", similarly to a kitten when suckling. This signals a really happy cat.

Distance decreasing signals are telling us to keep some distance and not to proceed with reaching or touching!

In an irritated or over-stimulated cat the pupils are dilating, the ears turning back, the tail is twitching or waving. The cat may growl or put her teeth on you as a warning to stop any further approaches. Even intense play can quickly turn to overstimulation in some cats, resulting in biting and scratching.

The nervous, insecure or fearful cat has her ears sideways or back, the pupils are dilated and the tail is low or tucked between legs. The body posture is lowered and she wants to turn away or hide.

The frightened or startled cat has her ears back and flat against head, the whiskers are back, the back can be arched. The fur might be standing up on the back, the tail can be erect or low. She might yowl, growl, hiss, and spit in some cases.

The fearfully aggressive cat displays a crouched body position with ears flattened and dilated pupils. The whiskers are back. The tail is between legs or wrapped around body. She may display a hard stare or growl, hiss or swat.

The offensive aggressive cat has her ears back with very constricted pupils. Her tail is up or down with fur standing on end. She may display a hard stare or growl, hiss or swat.

**References and further reading**


Dealing with the Shelter CAT-astrophy: Behavior Problems of the Shelter Cat
Jeanine Berger, DVM, DACVB, DACAW, CAWA
San Francisco SPCA
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Feline aggression is a very common behavior problem and can pose a challenge due to limited resources, space and time. More often than not a visitor or handler can easily become the target of the aggression. Bites to handlers pose a big problem in the shelter, as these animals will then have to be quarantined, which not only increases their length of stay, but further decreases their positive interactions with humans. In this presentation we will discuss approaches to feline aggression.

Dealing with the shelter CAT-astrophy: Behavior problems of the shelter cat
Feline aggression is very common behavior problem not only in shelter animals. Aggression can involve unsolicited attacks towards people or other animals. The injuries can range from mild scratches with claws to strong inhibited bites that break the skin. Bites to human handlers pose big problem in the shelter, as these animals will then have to be quarantined for 10 days, which not only increases their length of stay, but further decreases their positive interactions with humans during this time. This can then lead to a significant rebound effect of the aggression (quarantine = no visits). At the SPCA we have noticed that a numbers of bite cases involves young cats with a high play drive. Naturally, all young cats have the need to play, explore and “hunt”; however, some cats have a stronger need to perform these types of behaviors than others. To offer such opportunities in a shelter type situation can pose a challenge due to limited resources, space and time. The size of housing is often restricted, in addition to limited mental and physical enrichment opportunities. More often than not, a volunteer visitor or a handler is the only moving object and can easily become the target of the aggression. Play–related aggression sounds benign, but can still result in severe injuries depending on the bite inhibition. Different approaches to play aggression is needed in the young shelter cat, which starts with assessing young cats to determine play motivation and the initiation of a behavior plan specifically tailored to the needs of these young cats. In addition to implementing a behavioral treatment plan with proper mental and physical enrichment, it is equally crucial to teach handler and volunteers to read feline body language carefully. Body language, behavior, and vocalizations are key elements to understanding our feline friends, patients and shelter animals and continuous education is needed to improve communication. Indicators such as the look in cat’s eyes, the tone of her voice, the position of her ears, and the motion of her tail can provide important clues that reveal her feelings and intentions. One can learn to "read" these signals so as to get a better idea of what's on a cat's mind. However, keeping in mind that no feline mood can be completely interpreted without taking the entire body postures, vocalization and the situation the cat is in, into account.

Vocalization
The cat has indeed many different forms of vocalization. Most cat owners know when to give their cat attention or when it is time to feed her (at least in your cat’s opinion). They know when the cat is happy and most veterinarians have heard a really angry cat – those emotions are differentiated by the different tones and noises.

Facial expression
Eyes, ears and the mouth should be observed closely, as they can give important clues as to the mood of the cat. Pupils can be either constricted or dilated, but in general, fully dilated pupils can show either fearfulness or extreme playful arousal, either way not a good time to approach a cat. Fast swiveling ears for example signal a highly alert cat that might be very attentive and listening to every little sound and might readies itself to pounce. An open mouth with a lifted head and slightly flicking tongue is a cat that is doing the “Flehmen” response and is intent on taking in new smells. Most people can determine the difference between a fearful and a very confident cat’s body language.

Distance increasing signs to look for!
- Happy and Content: Sitting or lying down, eyes half-closed, narrow pupils, tail mostly still, ears forward, purring.
- Playful: Ears forward, tail up, whiskers forward, pupils somewhat dilated. Usually young cats. Different forms of play exist: object play, social play, predatory play.
- Rubbing: Chin and body against a person, tells us that the cat wants her smell on you, similarly as she rubs the couch and other things in her home. It is a sign of comfort and she might be marking her territory.
- Kneading: The cat uses both paws with a massage like motion mostly on a soft surface, some people call it "making biscuits", similarly to a kitten when suckling. When a cat does this, she is really happy.
Distance decreasing signals are not to be ignored!

- Irritated, over-stimulated: Pupils dilating, ears turning back, tail twitching or waving. The cat may growl or initiate biting as a distinct warning. Intense play can quickly turn to overstimulation in some cats, resulting in biting and scratching. Redirection is needed immediately before it escalates.
- Nervous, insecure, fearful: Ears sideways or back, pupils dilating, tail low or tucked between legs. Low body posture, wants to hide, turns away
- Frightened, startled: Ears back and flat against head, whiskers back, back arched, fur standing on end, tail erect or low. May yowl, growl, hiss, and spit.
- Fearful, aggressive: Crouched position, ears flattened, whiskers back, tail between legs or wrapped around body, pupils dilated. May meow loudly, growl, hiss, and spit.
- Aggressive, offensive: Ears back, pupils very constricted, tail up or down with fur standing on end. Hard stare or growl, hiss and swat.

Aggression towards people is a common feline behavior problem and can be roughly classified into fear-related, play-related, petting-induced, redirected and pain-related. Understanding feline-specific needs are crucial to prevent or treat human-directed aggression. Especially in a shelter environment stress needs to be recognized as a major element in aggression; however, exactly how stress mechanisms interact during feline aggression is yet poorly understood. Nonetheless, it is important to understand that the hypothalamic–pituitary–adrenal (HPA) axis is activated by behavioral responses. It is important to keep this in mind when addressing human directed aggression in the shelter, because often times exposure to unfamiliar people is perceived as a stressor or threat, and therefore the presence of a person can activate the physiological stress response.

When faced with the history of aggression in the shelter the veterinarian needs to determine whether the aggression is caused by medical or internal (metabolic/organic), psychological, or external triggers (people, animal, noises, smells, etc.). Pathological reasons for aggression have been reported to be more common in cats than in dogs. Medical problems can lead to irritable, pain-induced, or truly pathological aggression; therefore, a detailed medical work-up based on clinical signs is of utmost importance when treating any form of aggression. This can be a limiting factor in a shelter environment due to allocation of the resources.

Forms of aggression

Fear aggression
Cats with fear-aggression towards humans view humans as a threat. The triggers can include tactile, visual, auditory, and olfactory stimuli of humans. Fear behaviors are triggered by the “Flight or Fight” nervous system and are not under voluntary control. This from or aggression can be seen frequently in the shelter or at a veterinarian’s office. Due to the physiological aspect, these cats can show high arousal (dilated pupils, tense body language, hiss, piloerection) and when not given an opportunity to flee might attack in a defensive or even offensive manner. Most cats with this form of aggression display avoidance, or freeze-responses, and overt attacks are their last resort. There is no age or breed predilection for this forms of aggression. This behavior can be within the range of normal cat behavior, and is mostly determined by genetics and by environmental factors.

Play aggression
This a commonly reported form of aggression in young shelter cats due to confinement and can involve unsolicited attacks, anywhere from light scratches to hard uninhibited skin breaking bites. This form of aggression does often not include overt warning signs due to the nature of the aggression being play also thought to serve predatory practice. The postures of these cats include low body posture, hiding, stalking, chasing and pouncing. Shelter staff and volunteers should be educated as to play using their hands or feet, but rather, should use appropriate wand or string toys from the beginning.

Petting induced aggression
Feline social interactions often include the solicitation of attention by rubbing against humans and a cat might appear to accept or even enjoy physical affection from people but then suddenly becomes over-stimulated by these interactions and might turn towards the hand and bite. This is a common presentation in the shelter and is to some degree normal cat behavior, but might be seen due to deprivation of physical interactions and over stimulation during visits by volunteers. Underlying pain and discomfort to touch in certain areas must be ruled out.

Other forms of aggression include redirected-aggression where by aggressive arousal is elicited by any trigger other than the target and can include the sound, sight or smell of other animals or people, as well as any underlying pain and discomfort. The aggression is directed towards a seemingly irrelevant, but close-by target. This can be seen in a shelter with a cat displaying primary intercat aggression and handling or visiting staff or volunteers are the victims.

Rarely and often over-diagnosed is territorial and status aggression during which valuable resources such as territories, resting spots, food, mates or litter boxes are being defended. Territorial and status aggression is displayed by a very confident cat and it can occasionally be directed at humans, but most likely will be directed towards other cats.

The treatment of any form of human-directed aggression should combine management strategies, behavior modification, and can in some cases involve the use of medications.
Treatment plan

1. Management: Safety and Avoidance
   a. Identify trigger(s): Avoid and Redirect, Watch closely for playful body postures and redirect to appropriate play, Environmental Enrichment

2. Behavior modification:
   a. De-escalate aggressive behavior and reward for calm and relaxed behavior, never use physical punishment, implement multiple short visits (log outside the room)

3. Other treatments:
   b. Psychotropic medications, Pheromone or neutraceutical therapy, regular nail trims and clicker training
What to do about Shelter Cats with Inappropriate Urination
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House soiling is a common behavior problem in cats leading to a break in the human-animal bond, and consequently to relinquishment or euthanasia. A diagnosis is needed to successfully address these problems and their underlying causes. In this presentation, we discuss approaches and treatment plans for the most common inappropriate elimination problems with an emphasis on prevention: keeping animals in the home, and intervention: treatment plans for cats in order to maintain the human-animal bond.

“UR-in trouble” – thinking outside the box
House soiling problems are very common with cats, and can be divided into two general categories – urine marking, and inappropriate elimination. Cats diagnosed with either type of house soiling problem are at a higher risk for surrender and/or euthanasia. Both of these behaviors are normal behaviors for cats; however, a correct assessment has to be made to successfully address, treat, or manage these problems as well as their underlying cause.

Urine marking
Urine marking can be done either in response to a territorial reaction and/or anxiety. It is often related to tension and/or aggression between household cats or other stressors in the home, or shelter, and is therefore considered a “social communication problem”. Cats that mark, deposit small amounts of urine on vertical surfaces with social significance. Their litter box behavior is unchanged and when they urinate outside the box, they back up against a vertical surface and stand with their tail up straight to deposit a small amount of urine.

Inappropriate elimination
Inappropriate elimination, which can include urine and/or feces, is a “voiding problem” and is not done out of spite like some owners might think, but merely to empty the bladder in an area that is considered inappropriate to us. Those cats might soil on a specific surface, or in a specific location. They deposit a large amount of urine (void the bladder) on a horizontal surface. Their litter box use might be decreased or altered, but when they urinate outside the box they squat and many show pre- and post-voiding behaviors such as digging and covering.

As a first assessment for any urination problem a history needs to be taken, which is not always possible, especially at the shelter. However, when counseling owners for surrender prevention or for owner surrendered cats to the shelter, it is critical to obtain a history form. The minimal amount of information should include location, surface, amount of urine voided and posture of the cat while urinating. If a full history can be attained from a surrendering owner, it should include questions as to location, substrate, amount of urine and frequency of the soiling problem and the posture of the cat if observed while urinating. In addition to information on husbandry and environmental information such as the number and location of litter boxes in the home, litter type, litter box cleaning schedule, number of cats in the home or the presence of any outside cats and any past medical history.

Surrender prevention counseling: Marking and inappropriate elimination alike

Management
1. Because many medical problems can cause a cat to urinate outside the litter box, owners must be counseled to seek help from their veterinarian.
2. Because the odor of urine draws cats back to previously soiled areas, cleaning of all previously soiled areas with an enzymatic and bacterial combination cleanser is strongly recommended. This is of course especially important in the home, but also needs to be considered for shelters and includes items such as cat trees, bedding and any room furniture.
3. Excellent litter box hygiene has been proven to significantly decrease the incidence of any form of soiling. The boxes should contain non-scented, fine granulated, clumping litter and be scooped at least once daily and completely emptied and cleaned every one to two weeks. Strong smelling detergents, such as Pine-Sol®, ammonia, bleach should be avoid when cleaning the boxes, since cats typically do not like strong-smelling odors. Instead, it is recommended to use mild dish soap and rinse well. It is also worth pointing out that most cats do not like litter box covers, or liners.
4. Number of litter boxes: The magic number is N+1. There should be one more litter box than the total number of cats in the household. These boxes should be placed in multiple, easily accessible locations, including those locations that have been previously soiled.
5. Previously soiled locations should be made inaccessible. It is recommended to limit the cat’s access to rooms that have been soiled in the past. This can easiest be done by closing doors to those rooms. Alternatively, previously soiled locations could
be covered with an aversive substance. Some recommendations are: foil, plastic carpet runner material turned upside down so that the nubby side is up, Scat Mat®, contact paper with the sticky side up, double-sided sticky tape, etc.

6. Cats should only be interrupted if the owner actually sees the cat sniffing an area and is preparing to urinate, but never after the act. Never should any form of direct punishment (yell, stomp your feet, physically hit, etc.) be applied, as this only makes the cat either more nervous and fearful, or sneakier, and learn to urinate if the owners are not present.

7. All forms of environmental enrichment should be encouraged and recommended. This is good for any cat and might help to alleviate any anxiety or social tension that may be contributing to these problems. Some ways to do this are by providing more resting and hiding places, multiple feeding locations, and interactive toys. Meal times can be made more interesting by hiding small quantities of food around the house (on shelves, in bedding, in boxes, etc.) and in toys (with holes for food to fall out from). Toys can be made more challenging by hanging the containers just above the cat's head height. There are many commercially available interactive toys for cats. For older cats it can be helpful to place a litter box close to their favorite resting spot.

Inappropriate elimination in the shelter

At the SF SPCA we have treated/managed many cats with house soiling problems. Inappropriate elimination is more common than marking, and many cats have medical problems including renal failure, urinary tract infections, crystals, stones and neurological problems. Most cats are successfully treated, managed and adopted.

Shelter protocol for house soiling used at the SF SPCA

1. Diagnose the problem by attaining history from the previous home and observations in the shelter. However, even cats with a known history of either inappropriate elimination or marking might not show this behavior in the shelter due to change in environment. Therefore, it is important to attain as much history from a previous owner as possible.

2. A full medical work up including physical exam, blood analysis, urine analysis and urine culture and in some cases x-rays will be performed.

3. All cats with a history of house-soiling will be housed individually to treat elimination problems.

4. Behavior modification: Re-establish litter box use by offering a litter box trails: Depending on space two or more litter boxes with different litter type is provided for a minimum of 7-10 days. Daily use is recorded. Once a preference can be determined the other boxes are removed and the cat can be “challenged” by moving to a larger confinement space in addition to adding other types of substrates for example pillows or bedding.

5. Once solid litter box use has been established the cat will be made available for adoption with special behavior counseling and post adoption support is provided.

Key points for counseling

- Are there enough boxes? The magic number (n+1) is one box per cat in the household, plus one extra.
- Offer different types of litter to find the cats preferred litter type. Always offer a fine granulated, clumping and non-scented type of litter.
- Always keep the litter box clean. The box might be dirty and the laundry basket is the only “clean alternative”. Scoop out the litter box daily.
- Use mild dishwashing liquid to wash the box weekly.
- Location: Place the litter box in the same room the cat is eliminating outside the box.
- Please do not place litter box right next to food and water or your washer and dryer.
- If you have a multi-stored house, have litter boxes on each level, especially on the level where your older cat likes to rest.

Troubleshooting litter box problems

1. Always recommend to begin by consulting a veterinarian to rule out any medical causes.
2. Check all the above guidelines.
3. VERY IMPORTANT: Do not punish your cat for soiling, as this can make the problem worse and your cat more anxious.
4. In some cases the triggers cannot be found or avoided and medication is needed to control anxiety.
Osteochondritis dissecans (OCD) is a manifestation of osteochondrosis in which a flap of cartilage is lifted from the articular surface. Osteochondrosis is thought to proceed OCD and is a disturbance in endochondral ossification. The disturbance in endochondral ossification leads to multiple areas of cartilage islands on the surface and within the humeral epiphysis which have not undergone normal maturation into bone.

Areas of abnormal endochondral ossification of the articular surface become thickened and are susceptible to fissure and loosening (OCD) as the deeper chondrocytes undergo necrosis due to inadequate nutrition and a suboptimal microenvironment.

Large and giant-breed dogs are commonly affected and males are more often affected than females. Clinical signs often develop between 4 and 8 months of age; however, some dogs may not be presented for veterinary evaluation until they are mature. Affected animals are usually presented for examination because of unilateral forelimb lameness. Owners usually report a gradual onset of lameness that improves after rest and worsens after exercise.

On physical examination, the shoulder should be palpated and moved through a complete range of motion. Crepitation or palpable swelling of the joint is seldom evident, but affected animals usually exhibit pain when the shoulder is moved into hyper-extension or extreme flexion. Often the examiner can detect muscle atrophy of the forelimb by loss of muscle mass adjacent to the spine of the scapula.

Radiographs
Despite apparent lameness in only one limb, both shoulders should be radiographed because this condition is often bilateral. Sedation may be required for quality radiographs particularly in large hyper-active dogs. The earliest radiographic sign of OCD is flattening of the caudal humeral head. This is due to thickening of the articular cartilage and deviation of the subchondral bone line.

As the disease progresses, a saucer-shaped radiolucent area in the caudal humeral head may be visualized. Calcification of the flap may allow visualization of the flap either in situ or within the joint if it has detached from the underlying bone. In chronic cases, large calcified joint mice are often observed in the caudoventral joint pouch or cranially within the bicipital groove.

Forelimb lameness can be a diagnostic challenge in the athletic dog; often the lameness has been treated for months with no improvement. The only abnormal physical finding may be the observation of Grade 2 or Grade 3 lameness. The source of lameness may be attributed to soft tissue injury, bony injury or a combination of both. In the active adult dog the most common cause of latent forelimb lameness can be attributed to pathology in the elbow and to injury of the active and passive shoulder restraints. In the author’s experience, pathology in the elbow is regularly caused by occult microfracture/fragmentation of the medial coronoid process. There is no joint effusion, loss of motion, pain, or crepitus on physical examination. Radiographs are reported as normal or may show minimal subtrochlear sclerosis of the ulna.

Modalities to facilitate an accurate diagnosis in these cases are CT, nuclear scan, and arthroscopy. Recommendations for performing CT include scanning from the point of the olecranon to 2cm distal to the radial head. Scan thickness should be 1-2mm with .5mm overlapping slice index. Transverse slices using 1500 to 3500 HU are ideal for imaging subchondral bone and fragments of the medial coronoid; transverse images at 3500HU are considered ideal for identifying ostomalacic lesions of the medial coronoid.
Nuclear scintigraphy can be used to localize the origin of the lameness and can be used to facilitate detection of subtle pathologic changes before changes are evident on radiographs. Technetium phosphonates are typically used for scintigraphy of joint tissues. Scintigraphy has high sensitivity for detection of presence of elbow pathology but is not specific for definitive diagnosis. Regulatory issues often limit the use of scintigraphy to academic institutions or large referral practices. Nevertheless it is invaluable facilitating lesion localization in dogs with forelimb lameness. Most commonly, it is used to rule in or rule out elbow pathology. Note in the cases shown below the uptake in technetium in the involved elbow compared to the normal elbow. Each of the below cases had a long standing undiagnosed forelimb lameness. Radiographs of these cases were considered within normal limits. The use of scintigraphy localized the lesion to the elbow which then allowed application of more specific diagnostic modalities such as CT or arthroscopy.

Arthroscopy is more invasive than imaging modalities but is very specific for identification of pathology in the medial compartment of the elbow. A comparison of CT with arthroscopy showed that these procedures were complimentary for medial coronoid assessment. Care must be exercised when assessing the medial coronoid on CT and arthroscopically. Fragmentation of the articular cartilage, micro fissures and nondisplaced fragments may not be detected on CT. Likewise, with arthroscopy, thorough probing and or curettage adjacent to the radial head often will reveal abnormal bone or fragments beneath the cartilage surface not visualized on with casual observation.

Active and passive restraints of the Shoulder: Diagnosis and treatment
Forelimb lameness attributed to shoulder instability is reported frequently in the literature. Some orthopedic centers report the presence of subtle shoulder instability frequently where as others rarely diagnose the condition. The widespread difference in the frequency of diagnosis between clinics has led to disagreement relative to criteria for diagnosis of shoulder instability and the arthroscopic appearance normal intra-articular structures versus pathologic lesions. Stability of the shoulder is derived from passive and active restraints. Passive mechanisms include the medial and lateral glenohumeral ligaments, surrounding joint capsule, joint conformation, and synovial fluid cohesion. The medial collateral ligament (MCL) commonly appears as “y” shaped with the cranial
arm coursing caudally from its origin at the medial surface of the supraglenoid tubercle. The caudal arm of the MCL originates from the medial surface of the scapular neck and joins the cranial arm to insert onto the humeral neck. The MCL and associated joint capsule is a major factor in providing joint stability; complete medial luxation occurs following transection of the MGHL. The lateral collateral ligament (LCL) originates from the lateral rim of the glenoid and extends ventrally to insert onto the humerus at the caudal region of the greater tubercle. The joint capsule originates from the periphery of the glenoid cavity. Medially, the joint capsule forms a synovial recess due to its attachment several millimeters proximal to the glenoid rim.

Dynamic active glenohumeral stability is provided by contraction of the surrounding cuff muscles. These include the biceps brachii, subscapularis, teres minor, supraspinatus, and infraspinatus muscles. Active contraction of all or selective cuff muscles induce compression across the shoulder joint as well as increasing tension in the joint capsule. When tested in neutral position, the cranial, lateral, and medial translation of the humerus was significantly increased after biceps tendon transection. In the flexed position, translation of the humerus in the cranial and lateral directions was significantly increased after biceps tendon transection. In the extended position, the medial translation of the humerus was significantly increased after biceps tendon transaction.

Examination of the shoulder for stability should be done under anesthesia or heavy sedation. Flexion, extension, abduction, craniocaudal translation, and rotational stability of the shoulder joint should be assessed. Normal range of flexion and extension are 40 degrees for flexion and 165 degrees for extension. Circumduction of the shoulder should not give rise to subluxation. Anteroposterior translation should be similar in both shoulders. A normal abduction test is approximately 23 degrees; abnormal abduction is considered present when abduction exceeds this degree and there is a difference in abduction angle between the injured side and the normal side. When performing the abduction test, it is essential to maintain the limb in extension with the elbow in neutral position, i.e., one does not want the elbow externally rotated. If the elbow is externally rotated with the limb in extension, the shoulder joint will be internally rotated. The latter will give a false positive abduction test. To maintain the elbow in neutral position, the examiner should place his/her thumb on the lateral surface of the olecranon just posterior to the humeral epicondyle. Maintaining the thumb facing upward assures that the elbow remains in neutral position.
Care should be exercised in interpretation of side to side laxity difference. We have documented consistent abnormal abduction and AP translation is cases of long standing unilateral forelimb lameness. Our interpretation of shoulder laxity in these cases is that muscle and ligamentous atrophy give rise to increased shoulder laxity. In some cases, the shoulder laxity is secondary to long standing shoulder pathology such as OCD. Other cases are referred to our centers for treatment of shoulder pain. The pain is noted when the shoulder is placed in extension. By and large these cases are latent elbow dysplasia; the pain in fact arises from extension of the elbow when the shoulder is placed in extension.

Debate continues amongst surgeons as to the interpretation of the arthroscopic appearance of intra-articular structures. Some surgeons believe it is possible to detect increased intra-articular volume and redundant capsular/ligament structures within the joint while others believe this cannot be accurately detected arthroscopically. Further, the significance of intra-articular lesions remains controversial. While some surgeons believe small tears of the cranial arm of the MCL result in instability and require treatment, others believe these small tears are insignificant and most likely iatrogenic. The gutter medial to the cranial arm of the MCL adjacent to the insertion of the subscapularis is often diagnosed as a site of trauma. However, this zone often shows synovial proliferation with pathologic conditions of the shoulder such as OCD.
Supraspinatus strain
Dogs with strain of the supraspinatus tendon present with a chronic foreleg lameness; some dogs will exhibit periods of non-weight bearing lameness. Although uncommon, any age or breed of dog can be afflicted; however, the condition is seen more in large breeds of dogs (Labrador, Rottweiler). Radiographic views should include standard lateral projections of both shoulders. Mineralization is seen adjacent to the greater tubercle of the humerus. Patterns of mineralization are either irregular, non-homogeneous or well circumscribed and dense foci. A “skyline” view of the bicipital groove is helpful to delineate the location of dystrophic mineralization.

It is worthy to note that the mineralization of the supraspinatus insertion indicating chronic strain may be present but not be the cause of clinical dysfunction. Often mineralization is present in the shoulder in which the dog is not lame. Bilateral mineralization may be present (although different stages of mineralization can be seen between shoulders) and the dog only lame in one shoulder. Recently, MRI has been advocated as a diagnostic tool for shoulder lameness. Some surgeons believe that mineralization of the supraspinatus tendon displaces the biceps tendon causing biceps tendon pain. Although possible, ultrasound examination of the biceps tendon does not demonstrate inflammation secondary to biceps impingement. Also, the position of the biceps tendon is 3-5mm separate from the insertion of the supraspinatus tendon on the greater tubercle of the humerus. Arthrography can be used to outline the bicipital groove to determine if irregularities or filling defects suggestive of bicipital tenosynovitis are present. Diagnosis is based on clinical signs, imaging, and most importantly, ruling out other causes of forelimb lameness. Treatment is enbloc resection of the chronically inflamed section of the tendon. The tendon can be tenodesed in a position where it is exposed to less strain.

Bicipital tenosynovitis
Bicipital tenosynovitis is an inflammation of the biceps brachii tendon and its surrounding synovial sheath. The etiology of bicipital tenosynovitis is either direct or indirect trauma to the bicipital tendon or tendon sheath. Direct trauma due to repetitive injury may be an inciting factor and result in partial or complete tearing of the tendon. Indirect trauma secondary to proliferative fibrous connective tissue, osteophytes or adhesions between the tendon and sheath limit motion and cause pain. It has been hypothesized that mineralization of the supraspinatus tendon causes a secondary mechanical bicipital tenosynovitis. Affected dogs are usually medium- to large-sized, and middle-aged or older. Working and active dogs are more commonly affected; there is no predisposition for either sex. Intermittent or progressive forelimb lameness, which worsens after exercise, is common. The owner may relate the lameness to trauma, but usually there is slow onset of clinical signs. Radiographically, bony resorption at the supraglenoid tuberosity is characteristic of chronic strain at the origin of the biceps tendon. Medical or surgical management have been successful in treatment of bicipital tenosynovitis.

Medical treatment consists of injecting methylprednisolone acetate into the tendon sheath and restricting activity for 3 weeks. In one report (Stobie, JAVMA 1995) reported 50% of dogs treated medically had good to excellent outcome. In the same report, all dogs treated surgically had good to excellent outcome. Given these results, initiating treatment with 1 to 2 steroid injections is a reasonable approach. If outcome is not favorable, surgical intervention is advised. The bicipital tendon may show partial tearing of tendon fibers or partial tearing of the origin of the biceps tendon at the supraglenoid tuberosity. If the biceps tendon shows evidence of partial or complete tearing, the tendon is released by transecting the tendon just distal to the torn portion. Likewise, if there is evidence of synovial proliferation, mineralization, and osteophyte formation within the bicipital groove, the tendon is released from its origin. Tendon release may be performed with either a blade instrument (banana knife, beaver blade, or 11 blade) or a radiofrequency probe. The blade is slightly faster than the radiofrequency probe; however, use of the probe will prevent problems with hemorrhage from vasculature that is often present in the center of the tendon. Upon completion of tendon release, the tendon origin should be closely inspected for small osteochondral avulsion fragments, which can be removed with a motorized shaver or graspers. Lastly, the joint is thoroughly flushed
by increasing the ingress flow and allowing egress through a large instrument cannula. Inspect the joint for remaining pathology and then remove the arthroscope and instrument cannula. Suture the portals with non-reactive, non-absorbable suture.

**Elbow medial compartment syndrome**

It has been classically attributed to elbow dysplasia. The term canine elbow dysplasia is used to denote an abnormal development of the elbow joint which results in a degree of incongruence. It is used to describe developmental diseases which include ununited anconeal process, fragmentation of the medial coronoid process and osteoarthritis, all believed to be secondary to joint incongruity. The proposed incongruence results in mechanical overload of the medial coronoid/medial humeral condyle through establishment of a “short” radius or “long” ulna. The fact that fragmentation of the medial coronoid will occur with incongruence is well noted in cases of concentric distal radial physeal injury. The latter results in a short radius, mechanical overload of the medial coronoid, and microfracture/fragmentation of the medial coronoid. Does elbow dysplasia (incongruence) exist? Yes. No question elbow dysplasia is seen in younger dogs with developmental incongruence. Not the severe cartilage change and fragmentation of the medial coronoid in the young Irish Wolfhound in the figure.

However, elbow incongruence is not present in all dogs with elbow dysplasia; perhaps we do not have the imaging modality to detect subtle incongruence. Also, elbow dysplasia, a developmental condition that should be present from a juvenile age, does not account for the senior dog who has never experienced a lameness problem and presents with sudden onset lameness. The latter signalment/presentation accounts for the majority of forelimb lameness cases attributed to the elbow encountered by the author. As such, there must be other factors involved in the development of medial compartment syndrome.

**9 yr old Malanois with acute onset lameness: note fragmentation, no articular cartilage pathology**

Fitzpatrick (proc ACVS 2010) has shown with the use of micro CT that the pattern of trabecular fracture is consistent with acute traumatic overload (cranial tip fragment) or chronic rotational overload (radial incisures fracture). Recent work by Goodrich (proc VOS 2013) clearly has shown the weight bearing axis of the forelimb to be directed through the medial compartment. Also evident through CT of cases with medial compartment syndrome there increased bone density (sclerosis) in the medial compartment consistent with chronic repetitive mechanical overload. Acute mechanical overload directed through the medial compartment could easily account for the cranial tip fractures as described by Fitzpatrick.

**9 year old Retriever with sudden onset lameness; collapse medial compartment**

Repetitive mechanical overload generated by years of athletic or playful activity can account for the fragmentation and wear of articular cartilage.

Fitzpatrick has also proposed repetitive rotational overload as a possible cause of radial incisure fragmentation of the medial coronoid. The exact cause of the rotational load is not known but may be attributed to muscular forces (ex. contraction of the biceps/brachialis complex, Hulse Vet Surg 2010) or rotation of the medial humeral condyle against the radial incisure fo the medial coronoid (Bottcher proc ACVS 2013). Repetitive rotation of the medial coronoid by contraction of the biceps/brachialis complex compresses the coronoid against the radial head generating a shear stress which corresponds to the fracture plane of a radial incisures fracture.

Peter Bottcher has described rotation of the medial humeral condyle on the radial incises as a possible cause of fragmentation.
Treatment
Treatment of medial compartment syndrome includes fragment removal. This includes not only visible fragmentation but fragmentation which may be present beneath the articular surface (subtotal coronoidectomy). If surface articular pathology is present (abrasion) further treatment with medial compartment arthroplasty (abrasion arthroplasty, microfracture), decreasing medial compartment mechanical load (biceps release, sliding humeral osteotomy), and conservative modalities (weight loss, O-3 FA diet, exercise moderation, nutraceuticals, ACP, stem cell, adequan, polyglycan, NSAIDs) are indicated. If clinical lameness persists, joint replacement (CUE, Tate TER) are considered.

Fragment removal is achieved via arthroscopy or mini-arthrotomy. It is important to note that stress fractures may be present in addition to the obvious visible fragment. A limited subtotal coronoidectomy is advised. A radial incisure fragment in an adult Pittbull with sudden onset lameness. I yr prior to this surgery, a small fragment was removed. Dog never recovered. Repeat arthroscopy found this fragment beneath the articular surface. If clinical lameness persists, joint replacement (CUE, Tate TER) are considered.

Mechanical unloading of the medial compartment:
Biceps ulnar release procedure
The biceps/brachialis muscles constitute a large muscular complex. The anatomic origin and insertion of the biceps and brachialis muscles are such that the muscular complex exerts considerable force on the medial compartment of the elbow. The force exerted by the biceps is continuous since it is a pennate muscle with central tendon. More importantly, because the insertion of the biceps/brachialis complex is at the ulnar tuberosity, a large polar (rotational) moment is exerted at the cranial segment of the medial coronoid. The magnitude of the polar moment is a product of the moment arm (distance from the ulnar tuberosity to the tip of the coronoid) multiplied by the force created by the biceps/brachialis muscular complex. The polar moment rotates and compresses the cranio-lateral segment of the medial coronoid against the radial head. The compressive force is mediolateral transverse to the long axis of the coronoid. A compressive force generates internal shear stress at an oblique angle to the applied compressive force. In this situation, maximal internal shear stress would be oblique to the long axis of the coronoid. Under the right circumstances, the polar moment and resultant compressive force produced by the biceps/brachialis complex may produce sufficient internal shear stress to exceed the material strength of the cancellous bone in the cranio-lateral segment of the medial coronoid. The result would be microfracture/fragmentation adjacent to the radial head at an oblique angle to the long axis of the medial coronoid. The surgical technique involves releasing the ulnar insertion of the biceps to unload the medial compartment and prevent the rotational moment rotating the coronoid into the radial head.

Osteotomies: The deviation of the mechanical axis medially and the humeral varus become more apparent with the progression of medial compartment OA similar to the process in the human knee. The result of overload of the medial compartment, collapse to the medial compartment, and OA. Sliding humeral Osteotomy(SHO): Sliding humeral osteotomy involves creating a midshaft transverse humeral osteotomy and translating (sliding) the diaphysis distal to the osteotomy medially. Doing so shifts the weight bearing axis through the elbow joint from the medial compartment to the lateral compartment. Owner and vet VAS scores have improved in all cases with a notable decrease in pain upon elbow manipulation.

PAUL procedure
The PAUL procedure shifts the weight bearing axis through caudal tipping of the medial coronoid. Dynamic bi-planar ulnar osteotomy described by Noel Fitzpatrick as a method of unloading the medial compartment.

Arthroplasty
Management of articular cartilage lesions is based on the concept that providing blood with mesenchymal cell precursors access to the lesion; this encourages healing by formation of fibrocartilage. Several marrow stimulating techniques have been described to achieve this. Abrasion arthroplasty involves uniform removal of subchondral bone until bleeding is achieved. This can be accomplished in the canine elbow by use of either a curette or burr attachment on a small joint shaver. The shaver is usually more rapid and efficient and generally just as accurate. Another marrow stimulating technique is microfracture. In this technique numerous microcracks are created in the subchondral bone plate with a specialized micropick to allow bleeding at the lesion surface.
Objective evidence documenting the efficiency of abrasion arthroplasty or microfracture is not available in the dog. The figure to the right shows resurfacing of the medial coronoid in a dog 6 months after abrasion arthroplasty. In man microfracture appears to be more effective than abrasion arthroplasty and is the marrow stimulating technique of choice. The technique is highly dependent on appropriate postoperative rehabilitation. In man, 4-6 weeks of non-weight bearing activity coupled with active or passive range of motion is necessary for ideal outcome. Overall, the results of abrasion arthroplasty have been unpredictable and symptoms often recur 2-3 years after surgery. Nevertheless, good to excellent results are reported in 50 – 60% of patients.

Elbow replacement is an option in dogs which have end stage elbow OA and conservative/less invasive surgical modalities have not resolved clinical pain. A number of prostheses are available but the most popular one today is the TATE elbow. Clinical outcome studies indicate that a mechanical lameness may persist but that the dogs appear to be less painful. A prosthesis presently in clinical trial is the CUE (canine unicompartmental elbow). The concept is simple and carries little morbidity. Information concerning this technique will be forthcoming in the near future.
Hip dysplasia is an abnormal development of the coxofemoral joint. The syndrome is characterized by subluxation or complete luxation of the femoral head in the younger patient while in the older patient mild to severe degenerative joint disease is present. Laxity in the hip joint is responsible for the early clinical signs and joint changes. Subluxation stretches the fibrous joint capsule, producing pain and lameness. When the surface area of articulation is decreased, this concentrates the stress of weight bearing over a small area through the hip joint. Subsequently, fractures of the trabecular cancellous bone of the acetabulum can occur, causing pain and lameness. The cancellous bone of the acetabulum is easily deformed by the continual dorsal subluxation of the femoral head. This piston-like action causes a wearing of the acetabular articular surface from a horizontal plane to a more vertical plane causing subluxation to worsen. The physiologic response to joint laxity is proliferative fibroplasia of the joint capsule and increased thickness of the trabecular bone. This relieves the pain associated with capsular sprain and trabecular fractures. However, the surface area of articulation is still decreased causing premature wear of articular cartilage, exposure of subchondral pain fibers and lameness. This may occur early in the pathologic process or later in life. There are two general recognizable clinical syndromes associated with hip dysplasia: (1) patients 5 to 16 months of age, (2) patients with chronic degenerative joint disease. Patients in group 1 present with lameness between 5 to 8 months of age. Symptoms include difficulty when rising after periods of rest, exercise intolerance, restlessness at night, and intermittent or continual lameness. The majority of young patients will spontaneously improve clinically around 15 to 18 months of age. This clinical improvement is due to pain relief as proliferative fibrous tissue prevents further capsular sprain, and increased thickness of the subchondral bone prevents trabecular fractures. If symptoms occur later in life, they may include difficulty in rising, exercise intolerance, lameness following exercise, atrophy of the pelvic muscle mass, and a waddling gait with the rear quarters. Physical findings in the younger group of patients include pain during external rotation and abduction of the hip joint, poorly developed pelvic muscle mass, and exercise intolerance. Hip exam performed under general anesthesia will reveal abnormal angles of reduction and subluxation reflecting excessive joint laxity. Physical findings in the older group of patients include pain during extension of the hip joint, reduced range of motion, atrophy of the pelvic musculature, and exercise intolerance. Radio graphically, there are seven grades of variation in the congruity between the femoral head and acetabulum established by the Orthopedic Foundation for Animals. Excellent, good, fair, and near normal are considered within a range of normal. Dysplastic animals fall into the categories of mild, moderate, and severe. It is important to note that clinical signs do not always correlate with radiographic findings. Recently, patients have been evaluated using a distraction index where the degree of hyperlaxity is measured and correlated with standards for each breed.

Treatment is dependent upon the age of the patient, the degree of patient discomfort, physical and radiographic findings, client expectations of patient performance, and financial capability of the client. Conservative treatment is beneficial to a large number of patients in both the young and older patient groups. Conservative management is divided into acute management and long term management. When a dog exhibiting signs of hip dysplasia enters the clinic, it is generally because they have sprained the hip joint. The dysplastic joint is either hyper lax (young dog) has a limited range of motion (mature dog). In either case, the joint is easily sprained and the dog that is presented with symptoms has generally overused (sprained) the hip joint. The management of the case at this time period is the same as treating any other acute sprain. Rest, physical therapy, and non-steroidal analgesics will relieve signs in the majority of patients. Rest is just that!!!, controlled activity with slow walking on a leash only. There should be NO free activity for 2 weeks. Physical therapy includes cold therapy for the initial 1-4 days. Commercial cold packs are the most convenient and precise way to apply cold therapy. The application of cold should only be 5-10 minutes. The attending veterinarian must emphasize that REST and PT are the most important considerations when treating an acute sprain.

Following the acute phase of treatment, the attending veterinarian must consult with the owner regarding longterm management of the dysplastic dog. The foundation for long term management of any arthritic joint is weight control, exercise therapy, and anti-inflammatory drugs or supplements. The majority of mature dogs with hip discomfort are overweight. Studies have shown a significant improvement in function if an ideal target weight is achieved. The foundation for weight control is exercise therapy, diet, and owner behavior modification. Administration of drugs (NSAIDs, steroids, PSGAGs, Hyaluronate) or supplements (glucosamine, chondroitin sulfate, manganese) are useful to control discomfort. This is particularly true in the early stages of treatment before the benefits of weight reduction and exercise therapy are realized. The administration of drugs should be at a minimum level (dose and frequency) to achieve comfort. Supplements of glucosamine, chondroitin sulfate and manganese alone or in combination have been shown in vitro as well as in clinical studies to ameliorate discomfort or reduce the dose of drugs needed to control discomfort.

Surgical intervention also is divided into techniques useful in the younger population and those useful in mature dogs. Techniques useful in the younger population include Triple Pelvic Osteotomy (TPO), Double Pelvic Osteotomy, femoral head ostectomy, and possibly total hip replacement. My preference in this aged dog is either a TPO or DPO. The advantage of DPO is that the floor of the
pelvic canal is stable is that the ischium does not undergo an osteotomy as in a TPO. This concept allows for greater patient comfort and therefore, the ability to perform a bilateral DPO at the same setting. This reduces postoperative rehabilitation time and allows more rapid return to function. Pelvic osteotomy is used in the group of younger patients to axially rotate and lateralize the acetabulum in an effort to increase dorsal coverage of the femoral head. This procedure is indicated in patients that will lead athletic lives such as the working breeds or in those patients in which the client wishes to arrest or slow the progress of osteoarthritis associated with hip dysplasia. The most favorable prognosis is in patients having minimal existing radiographic degenerative changes and an angle of reduction less than 45 degrees and angle of subluxation less than 15 degrees. The prognosis is less favorable in patients with existing degenerative changes and angles of reduction and subluxation greater than those given above. The details of the technique are beyond the scope of this handout. Briefly, the degree of axial rotation of the acetabulum is set by the previously determined angles of reduction and subluxation. The angle of reduction is the maximum degree of rotation and the angle of subluxation is the minimum degree of rotation. The most commonly used angle of acetabular axial rotation is slightly less than the measured angle of reduction. The pelvis is cut through the pubic brim and body of the ilium. The acetabulum is rotated axially, lateralized and stabilized with the appropriate osteotomy plate. The use of locking technology is an advantage that has decreased post operative implant failure. Postoperatively the patient is restricted to exercise on a leash only until radiographic healing of the osteotomies is complete.

In the older dogs, my preference is total hip replacement or conservative management. Femoral head ostectomy is an option in cases where conservative management is no longer effective and financial constraints precludes Total Hip Replacement. Advancement in Total Hip Replacement is the advent of cementless systems. Cementless systems have decreased the incidence of acetabular cup loosening and femoral stem loosening. Hybrid insertion with cementless cup and cemented stem are often used in dogs with “stove pipe”, ie, uniform diameter marrow cavity.

**Diagnosis of the CCL deficient stifle**

**Examination**

Perform the initial examination of the stifle with the animal standing. Simultaneously palpate both stifles to detect swelling. A swollen stifle usually indicates degenerative joint disease. The patellar ligament becomes less distinct with joint effusion and the medial aspect of the stifle enlarges because of capsular thickening and osteophyte formation. Palpate the stability of the patella with the hip joint in full extension. Ask the animal to sit; observe the flexion of the stifle and tarsus. The earliest sign of stifle joint pathology is failure to dorsiflex the tarsus fully (compare to the opposite normal side).
Imaging

Early diagnosis is dependent upon radiographic presence of joint effusion. A radiolucent line adjacent to the caudal joint capsule is representative of fatty tissue in the space between the joint capsule and popliteal muscle. Caudal displacement of this line is representative of joint effusion. This is one of the earliest radiographic indications of partial anterior cruciate ligament injury. As changes progress, typical radiographic signs of DJD will be noted.

Stabilization of the CCL deficient joint can be accomplished through a variety of methods. Surgical techniques have been developed including placement of intra-articular grafts, insertion of suture material and/or advancement of periarticular structures outside the joint (extracapsular), and tibial osteotomies that alter joint mechanics. The technique of choice is based on surgeon experience. Tibial plateau leveling techniques are preferred by the author in large athletic breeds, with early partial CCL injury, and in dogs/cats with excessive slope. Recent double blind study showed that in larger breeds of dogs, the Nylon crimp technique was not as effective in all outcome parameters as a leveling osteotomy. A number of reasons why the nylon / crimp technique is ineffective have been elucidated. The placement of the nylon (attachment sites at the femur/tibia) are very non-isometric and predispose to suture elongation/breakage. The nylon material itself undergoes stress relaxation/creep, ie, elongates under continual load. Newer materials (Arthrex FiberWire/Tape) have improved structural/mechanical properties. More isometric sites have been identified; note the ligament is very complex and there is no true one isometric site. Studies in our lab at TAMU have identified near isometric sites. A discussion of the site(s) location and technique of application are presented below. Additionally, a leveling osteotomy technique is described for those who wish to apply this method based upon personal preference/indications.

Recommended sites for isometric suture placement

Locating the F2 site

The F2 site is located at the level of the distal pole of the fabella. Placement of the anchor is critical. The anchor must be placed in the femoral condyle as far distal and as far caudal as is possible. An anchor placed to far proximal or anterior is at risk for pull out or suture failure. To locate the correct placement site in the femoral condyle, palpate the distal pole of the fabella. Make a vertical incision through the capsular tissue to expose the joint line between the fabella and caudal margin of the femur. Locate the proper position for the anchor just distal to the fabella-femoral joint line and as far caudal as possible. A hole is pre-drilled with a 2mm drill bit (or 1/16 Steinmann pin) at the correct anchor position. The drill hole is angled directed toward the patella to cranial to eliminate the risk of entering the joint. Insert the appropriate size anchor.
Locate the T3 site at the proximal tibia
First locate the protuberances cranial and caudal to the long digital extensor groove. Make a vertical incision through the capsular tissue overlying the extensor groove. Palpate and locate the protuberance just caudal to the extensor groove; this is the site for placement of the first drill hole. At this site beginning as proximal as is possible without entering the joint, insert a .045 k-wire. The K-wire is directed to glide beneath the extensor groove to exit through the medial cortex of the proximal tibia. With the K-wire in place, place a 2mm cannulated drill bit over the wire to create the first drill hole. Drill over the K-wire to exit through the medial cortex. Leave the drill bit in place and remove the K-wire. Through the cannulated hole in the drill bit, place a nytinol Arthrex suture passer such that the loop is lateral. Remove the drill bit and leave the suture passer in the drill hole.

Passing the suture through the drill hole
Place one of the suture ends through the loop in the nytinol suture passer. Only place about 1cm of the suture through the loop to decrease suture drag as it passes through the drill hole. Pull the suture passer medial such that the free end of the suture exits through the medial cortex. Place the free end of the suture through a two hole button such that the button will lie against the medial cortex when the suture is pulled taught. Reinsert the nytinol suture passer through the drill hole such that the loop is positioned medial. Place the free end of the suture through the nytinol loop (1cm of suture end) and pull the suture laterally. Now both free ends of the suture are lateral and ready to be tied.

Tying the suture
Place the limb in normal standing position (140 degrees). Place the initial double throw of a surgeon's knot and check cranial drawer. Do not over constrain; there should be 2-3mm cranial translation. When satisfied with stability, complete the surgeon's knot and place 4 additional half throws. Check range of motion and cranial drawer.

Knotless swivelock
The 5.5mm PEEK SwiveLock is recommended for dogs weighing 50lbs or greater. One strand of 2mm Fibertape (2 limbs) is inserted for dogs up to 70 lbs or so; two strands (4 limbs) of 2mm fiberTape is recommended for dogs greater than 70 lbs. The F2 and T3 sites described previously are used in this application.
Concept of CORA based leveling osteotomy
Recent studies have shown joint mechanical alteration that may be contributory to articular cartilage lesions noted on 2nd look arthroscopy. One explanation for reported abnormal joint mechanics with Tibial Plateau Leveling Osteotomy is that the standard Slocum osteotomy is not based on the anatomic CORA. As such, the Axis of Correction (ACA) is not aligned with the anatomic CORA resulting in mal-alignment of the proximal and distal anatomic axis and secondary translation. The result is caudal displacement of the weight bearing axis and a focal increase in joint force. When rotated to the recommended 5 degrees, the long-term effect is loss of compliance of cranial supporting structures such as the fat pad and joint capsule. Encroachment of the cranial supporting structures (joint capsule) on the cranial articular surface of the medial/lateral femoral condyles can result in abrasion of the articular cartilage.

Surgical techniques for stabilization of the patella

Deepening of the trochlear groove
If the medial and lateral trochlear ridges do not constrain the patella, the trochlear groove must be deepened. This technique is generally necessary in dogs/cats with a grade III or IV luxation. Deepening the groove may be achieved with a trochlear wedge recession, trochlear block recession, or trochlear resection.

Trochlear wedge recession deepens the trochlear groove to restrain the patella and maintains the integrity of the patellofemoral articulation. Make a diamond shaped outline cut into the articular cartilage of the trochlea with a scalpel (use smooth arcs rather than corners on the lateral and medial sides of the diamond). The width of the cut must be sufficient at its' midpoint to accommodate the width of the patella. An osteochondral wedge of bone and cartilage is removed by following the outline previously made. Make the osteotomy so that the two oblique planes intersect distally at the intercondylar notch and proximally at the dorsal edge of the trochlear articular cartilage. Use caution to avoid making the wedge too long (may affect cruciate ligament insertions) or too deep (may go through the caudal aspect of the femur).

Trochlear block recession
Is performed similarly to the wedge recession. Some surgeons find the block recession most appropriate for dogs that seem to luxate primarily with the stifle joint in extension, and for larger breed dogs. The advantage of the block recession is deeper placement of the patella and more advantageous proximal tracking of the patella into the trochlear groove.

Tibial tuberosity transposition
Tibial tuberosity or crest transposition is an effective method of treatment for grades II, III, and IV patellar luxations. Medial release: The medial joint capsule is thicker than normal and contracted in patients with grade III or Grade IV patella luxations. In this group of animals, the medial joint capsule and retinaculum must be released to allow lateral placement of the patella. The pull of the sartorius muscles and vastus medialis muscle directs the patella medially, the insertions of these muscles at the proximal patella are released. Redirect the insertions and suture them to the vastus intermedius.
**Lateral reinforcement**

Reinforcement of the lateral retinaculum is accomplished with suture placement and imbrication of the fibrous joint capsule, by placement of a fascia lata graft from the fabella to the parapatellar fibrocartilage, patella sling suture, or excision of redundant retinaculum.

Femoral varus/valgus correction is required in cases where the angulation of the distal femur precludes correct alignment of the extensor mechanism. This abnormal / excessive varus/valgus is present with cases of Grade 4 patella luxation. The method of planning correction is based upon the CORA methodology. CT imaging and reconstruction are the most accurate method of determining correction. In severe cases, prototype development is ideal. Many centers do not have the ability to perform CT/reconstruction and prototype development; accurate radiographic positioning and planning will suffice except in the more severe cases. These cases can be very complex and therefore recommended only for the experienced surgeon.
Aquatic therapy
Aquatic therapy is the use of the therapeutic properties of water to provide appropriate exercises for strength, range of motion and endurance while reducing the risk of injury.

The therapeutic thermal effects of water are the same as for superficial heat only more systemic. Passive range of motion and stretches can be performed in warm water to increase stretch and range of motion due to increase in tissue extensibility. The soothing effects of warm water reduce pain and may increase the dog’s ability to exert more effort.

Buoyancy property of water is used to increase or decrease the amount of weight bearing on joints and bones.1

Reduce Body Weight by 9%-Reduce Body Weight by 15%-Reduce Body Weight by 62% -36% -64% -37% -63% -29% -71%

The actual effect of buoyancy can be very dramatic. Reducing the body weight of the dog by approximately 60% can reduce the amount of stress on a weak joint to allow the dog to exercise in more natural gait pattern and move more comfortably.

Swimming and use of the underwater treadmill are exceptional therapeutic exercises for the canine. The unique effects of the underwater treadmill include the ability to vary the water depth to increase or decrease the amount of weight bearing the dog has while exercising, vary the speed of exercise, and to control the water temperature closely due to small body of water. Increasing the water temperature can stimulate metabolism, relax tight muscles, help reduce pain, and increase soft tissue extensibility. Swimming is an excellent cardiovascular exercise and is indicated when zero weight bearing is desired. The swimming dog may not extend the stifle or hip joints. Walking and trotting in the underwater treadmill provides normal flexion and extension of joints with reduced impact and provided more benefit in the majority of rehabilitation regimes.

Exercise therapy
Canine exercise therapy is an active rehabilitation technique using the dog’s natural ability to perform activities. This form of therapy is designed to return the dog to function sooner and to lessen the risk of future injuries. The level of each exercise will vary with the post operative stage of the dog.

An exercise therapy program begins with short duration, low impact activities and progresses to longer time periods with more strenuous activities. The exercise session should include at least one exercise from each of the following sections: strength, endurance, range of motion, and balance.

Strength activities increase the number of muscle fibers and cross sectional area of the muscle unit.

Endurance activities increase the oxidative capacity of the muscles. This reduces the fatigue of the animal.

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1 Tragauer V, Levine D, PT, PhD, OCS, Millis, DL, MS, DVM, Percentage of Normal Weight Bearing During Partial Immersion at Various Depths in Dogs, University of TN College of Veterinary Medicine, Knoxville, TN, USA, Presented at the 2nd International Symposium On Rehabilitation and Physical Therapy in Veterinary Medicine. Knoxville, Tennessee, USA, 2002.
Range of motion exercises provide:

- Maintenance of physiologic elasticity and contractility of muscles
- Sensory feedback from the contracting muscles
- Development of coordination and motor skills required for functional activities

Balance or proprioception exercises are important to increase the dog’s physiologic protective mechanisms.

Post exercise therapy includes icing the affected muscles to reduce any inflammation or micro-trauma that may have been caused during the exercise session.

**Proprioception exercises**

**Physioroll**
The ball should be at the wither height of the dog when he is standing. Air can be added or removed to help make the ball the right size. While many dogs may resist being placed on the ball initially, most dogs relax after rhythmic movement or bouncing begins.

Place the dog on the ball so that the trunk is supported. Gently roll the ball until the front legs come in contact with the ground. Hold and bounce gently for 10 to 20 seconds. Then gently roll the ball so the front feet come off the ground and the back feet touch the ground. Gently bounce for 10 to 20 seconds. The weight is gradually shifted from front to hind limbs and then back again. The amount of weight can be increased or decreased depending on the amount of roll and pressure on the ball. The dog will use trunk muscles to stabilize himself.

**Balance board**
Place front feet or back feet on balance board. Rock side to side for 20 repetitions. Then turn board and rock front to back for 20 repetitions. Dog will contract muscles and shift weight to stay on balance board.

**One leg standing**
Lift the leg contra lateral leg. Hold for 10 – 15 seconds. Repeat 2-3 times. Increase time and repetitions as dog’s strength is increased.

**Cross leg standing**
Lift the leg contra lateral leg. Once the dog is balanced, lift the diagonal rear leg. Hold for 10 – 15 seconds. Repeat 2-3 times. Increase time and repetitions as dog’s strength is increased.

**Cavaletti exercises**
Cavaletti Poles can be used to increase range of motion, stride length and stance time in the dog.

Start with poles approximately the same distance apart as the height of the dogs elbow. Trot dog through the poles. Raise, lower or spread apart to reach desired gait.

**Sit to stand**
Place the dog in a sit position by command or with assistance. Hold a treat at the level the dogs head will be when he stands. Ask the dog to stand.

**Down to stand**
Place the dog in a sphinx down position by command or with assistance. Hold a treat where the dog’s head will be when he stands. Ask the dog to stand.
Gait training
Chronic pain or traumatic injury can cause a dog to alter his movement. This alteration in gait may cause pain or injury to unaffected limbs. Gait training techniques and exercise focus on returning the dog to as near normal movement as possible.

Theraband is an elastic resistance material that can be tied at different locations on limbs to apply resistance or stabilization through the dog's gait pattern. Be careful not to tie the bands so tight that circulation to the limb is compromised. One example is placing the theraband distal to the tarsal joint as medial and lateral stabilizer of rear limb.

Irritate contra lateral limb – tape a syringe cap on the paw of the contra lateral limb to cause just enough discomfort in the weight bearing limb to encourage weight bearing on the affected limb.