Accurate patient assessment is vital to a successful anesthetic procedure. Part of the total patient assessment is the patient history. Many critical patients present acutely; this does not mean the condition is also acute. Oftentimes acute debilitation is a pinnacle of a chronic underlying condition. Taking a detailed history of diet and husbandry is pivotal in determining a diagnosis and treatment plan. One of the leading causes of illness in exotic small mammals is nutritional and husbandry ignorance, such as vitamin and mineral deficiencies. Determining an animals' "normal" or "pre" operative vital signs and pain score during a thorough physical exam will help aid in anesthetic monitoring and anesthetic/analgesic protocol. Watching the patient in a quiet non-threatening environment is best for gaging the respiratory rate, as well as the patients’ “normal behavior”. Auscultation of the heart and lung sounds should be done in the most stress free method as possible. Having the animal held by a familiar owner, together with allowing the patient time to acclimate to you and your stethoscope by encouraging them to sniff around can prove useful. Critical patients that present in a more compromised state may not need this acclimation, and a physical exam should be done quickly to expedite treatment.

Pre-Anesthetic Preparedness
Being prepared is essential for a successful procedure, not to mention hastening induction, anesthetic time and recovery. Everything one will and might need should be at hand or setup prior. Cheat sheets of emergency drugs should be made and, although a bit wasteful, pre drawn in the event of an emergency. Some essential supplies when working with exotics include a 0-0 Miller blade laryngoscope, small cuffed and un-cuffed endotracheal tubes (sizes 1-4.5mm), a variety of lightweight heating implements (i.e. bubble wrap, wool socks, heat lamps), syringe pumps, 25-27g IV catheters, an assortment of tight fitting masks and insulin syringes.

Premedication:
As in small animal, premedication is ideal. Anxiety in small exotic animals can induce dyspnea as well as the release of systemic epinephrine and cortisol, which can result in complications while under anesthesia. Premedication in exotic species often amounts to tranquilization or heavy sedation. Many exotic species will not sit quietly for IV induction methods like a cat or dog. Just as there is a plethora of premedication cocktails for small animals, just as many exist for exotic small mammals. Drug selection should be based on what would be best for the patient taking into account current research. Anticholinergics such as atropine are less desirable in some species. For example, 40% of rabbits have atropinesterase, which renders atropine inept. Atropine in many mammals has a relatively short half-life and can cause gastrointestinal stasis, which can upset sensitive GI tracks. Glycopyrrolate is a better option in small exotic mammals if an anticholinergic is needed at all.

Local Anesthetics:
All of the same methods used in small animal can be employed with exotic small mammals (regional blocks, epidurals, line blocks, etc.). Little alteration of dosing protocols need apply in comparison to small animal medication choice. Anatomy seems to be the biggest hindering factor for exotics.
**Venous Access:**

Intravenous catheterization in exotics can prove challenging, but may be crucial to the animal especially if a blood transfusion is warranted. The option of accessing ear veins is available in species such as rabbits and mini pigs. Take heed there is a potential for ear sloughing in rabbits if certain medications leak perivascularly. Rats and mice can be catheterized via the lateral tail veins. Special micro catheters commonly used in the lab animal setting may be a worthwhile investment if your practice anticipates exotic pets, be it on a regular basis or intermittently. Some exotic pets such as mini pigs, small primates, and the occasional rabbit can tolerate femoral catheterization; however, this method is less ideal for continuous use post procedure where the animal is expected to be ambulatory. *Arterial femoral access using a 22 gage catheter is ideal for invasive blood pressure monitoring.*

Bats, although not a common nor generally legally kept exotic animal to own, have accessible wing veins. It is better to stay with vessels in the hind limbs before using the wing approach as they can have similar sloughing effects seen with rabbit ears.

The vascular anatomy in a bird can make blood pressure monitoring and catheter placement more interesting compared to our mammal patients. Depending on the size of the bird an IV catheter can be placed in the right jugular vein, basilic vein or medial metatarsal vein. In smaller birds, one may find it easier to place an IO (intra-osseous) catheter. Anatomic sites used for IO catheter placement include the distal ulna (larger birds), lateral femur (young and small birds), proximal ulna and proximal tibiotarsus bone. Reptilian IV catheterization poses a more difficult challenge. Often IV access in reptiles will require a cut down. In large species tail veins are accessible percutaneously. In Chelonians jugular access is readily available after light sedation. For amphibians, taking advantage of their ability to soak up fluid and absorb chemicals through their skin should be taken advantage of. Intraosseous methods are well described in many small exotics and are fairly easy to place. Intraosseous catheterization using a spinal needle, IV catheter stylette or regular hypodermic needle can be used for this method. A sterile piece of cerclage wire may be needed to clear our boney material. *Appropriate local anesthetics, sedation and proper management should all be well thought out if IO catheterization is utilized.*

**Induction:**

Traditional IV induction can be challenging. Preoperative sedation is highly recommended to alleviate stress to the animal, personnel safety and ease of various procedures, such as IV catheterization. Although, veterinary practices should strive to get away from mask or chamber induction this is the most practical method in some patients. Some authors even recommend it for birds for a quicker recover. Induction via the IV route should be used on a case by case basis. Induction in exotics should go hand in hand with pre-oxygenation. Pre-oxygenation allows a reservoir effect at only one minute 100% O2, but should be extended in compromised patients up until intubation is complete.

One of the more challenging skills required when working with a variety of small exotic animals is knowing different intubation techniques. In many exotic mammal species, we don't have the luxury of visualizing an epiglottis, but instead must rely on blind intubation. Certain special species, like rabbits, can pose a challenge to the practitioner. Since intubation in rabbits is commonly performed blindly the skill requires practice. Rigid or flexible scopes or careful use of a 0-0 Miller blade or use of other modified laryngoscope blades may come in handy. In guinea pigs, an appropriate size to patient mouth ear cone can be used for visualizing the palatal ostium within the patient’s mouth.

*Guinea pigs and hamsters have a tendency to store food in their cheeks, and careful attention should be taken to remove food debris before a procedure.*
For any technique, a second person should be utilized to offer supplemental oxygen at the nares or mouth. When using topical anesthetics to prevent laryngospasms, medications such as benzocaine should be avoided for its methemoglobinemia (MetHb) producing effects. Many of the drugs in the topical anesthetic family can produce MetHb, even lidocaine! Oftentimes an animal can have a normal SpO2 alongside a small to moderate methemoglobinemia without the practitioner knowing. Few blood gas and chemistry panels have MetHb as a value, but the potential of this condition occurring should not be overlooked.

Reptilian, amphibian and avian intubation is fairly straightforward. They lack an epiglottis making visualization easy. Reptiles and amphibians also have a very cranial tracheal opening making intubation even more clear.

*Careful attention to the force and attempts made is vital as soft tissue damage can occur leading to inflammation, ulceration and abrasions.

*Primates can be intubated in sternal or dorsal recumbency. The author finds dorsal recumbency to provide better visualization.

In the event an animal cannot be intubated the forced mask ventilation technique may need to be utilized depending on the species. This technique consists of fitting a patient to a mask that completely covers the nose and mouth. The head should be placed so that the trachea is fully extended in order to allow easier movement of air. There are various pre-manufactured masks, but at times it is necessary to create a homemade mask out of syringe cases, small bottles or tubing. If the forced mask ventilation technique is used, it is important to remember to protect the animal's eyes! Too often a mask is placed erroneously, placing pressure on the inferior eye socket. This technique can also lead to gas in the stomach that may need to be treated postoperatively by tubing or carefully expressing the air out.

*Rabbits in particular have a thin stomach wall, and over inflation can cause rupture and hinder normal tidal volume intake.

**Monitoring:**

Anesthesia monitoring for exotics greatly echoes cat and dog anesthesia. Special monitoring equipment used in the research setting can better accommodate higher heart rates seen with smaller mammals and offer more reliable ECG tracings. Pediatric settings should be utilized on all monitors if conventional monitoring equipment is used. Laboratory animal vendors also offer miniaturized anesthetic machines, eliminating dead space that we see in regular sized anesthesia machines. Micro ventilators are also available, which are specially designed for patients in the 150-400 gram weight range. If you find yourself spending more time setting up a patient with every bell and whistle, prolonging anesthetic time, it may be more advantageous to simply finish the procedure without every monitoring gadget attached and go back to basics. Being able to use ones stethoscope, eyes, ears, touch and intuition are just as vital as any piece of monitoring machine.

Appropriate and inappropriate gas exchange in special species has the same positive and detrimental effects as it does in dogs and cats, but resiliency to hypercarbia can be less appreciable in mammals and birds. Reptiles and amphibians can tolerate anoxic conditions better by being able to switch to an anaerobic metabolism.

*In diving species of birds, reptiles and mammals, gas exchange can prove challenging without mechanical ventilation and appropriate anesthetic depth.

Because the surface area to body mass is high in many small exotic patients, maintaining a normal body temperature is challenging, yet critical. The cooling effects from surgical scrubbing will add to this challenge. Normothermia will help retain a steady metabolic rate and aid in keeping a normal blood pressure to perfuse our patients’ vital organs.
With tiny or anatomically challenging species, like a hedgehog or hummingbird, intubation and blood pressure monitoring may not be as feasible for all of our patients. This makes it even more crucial to maintain the optimal temp for a particular species. Using warming devices such as warmed surgical tables and circulating warm water blankets work well. *Caution should be taken not to allow direct contact with the patient, in order to avoid thermal burns. Recently warm water bags have been shown to have an opposite effect and can steal heat from an anesthetized patient as they cool. Warm air blowers are ideal, but can be cumbersome with such tiny patients. A personal favorite is bubble wrap. Not only is it cheap and disposable, it also offers a lightweight and insulated option in thermoregulation. Tiny knitted socks work well to cover exposed limbs. Humidivents™ are also a good option, but can add to dead space and IPPV may be indicated. These devices work by inserting the device between the ETT and the circuit hose. The paper filter keeps warm moist air in the chest cavity. They also help protect the anesthesia machine from aerosolized bacteria the patient may be harboring with expiration. As a last resort, warm water enemas can be used in extremely cold patients, but a cooling evaporation effect can occur if the patient becomes wet during the process. *A rabbits ears comprise around 12% of the animals' surface area and a bats wings comprise about 85% total body surface area and can be used to cool quickly or warm a patient.

Cardiovascular and blood pressure management also greatly resonates the methods used in small animals. A staple in avian, reptilian and amphibian anesthetic monitoring is the ultrasonic Doppler. The crystal can be placed in multiple different sites and also gives an audible indicator as to the pulse rate and quality. Most commonly the crystal is placed on the radial artery or tibiotarsus artery is birds. Here a blood pressure cuff can also be placed proximally to the crystal for non-invasive blood pressure monitoring. Other sites include the jugular vein and palatine artery of the dorsal bill. Placing the crystal over the heart in reptiles and amphibians is the most common site. In larger species ventral placement on the tail or an very well lubricated eyes is efficacious.

Arterial blood pressure monitoring is the gold standard in any species. In medium to larger sized birds, placement of the arterial catheter at the brachial or carotid arteries has been performed. Having IV access is crucial in supportive cardiovascular support either by medication or appropriate crystalloid or colloid infusion. Constant rate infusions of dopamine, dobutamine or phenylephrine can be used after volatile gasses are titrated down or after the start of a multimodal anesthesia protocol with MAC reducing CRI's of analgesics or other anesthetic agents for blood pressure management. The animals’ temperature should be normal and other contributing factors addressed before moving to BP supporting medications that can cause tachycardia among other arrhythmias. Most small mammals have a quick metabolism requiring a high caloric intake to keep glucose levels in normal range. Even short fasting preoperatively in combination with possible poor appetite due to the patients underlying condition even more greatly affects a patients glucose levels. Although current fluid therapy is leaning away from the addition of dextrose in fluids, it still may be necessary if the patient has been anorexic prior to the anesthetic event, is aged or a neonate. Using a balanced crystalloid fluid made to 2.5-5% dextrose solution is recommended and can even be given SQ in the worst case scenario. Having quick recoveries with a normal temperature will only better your patient's odds by regaining caloric intake as soon as possible. Remember an ill or recovering patient has a greater demand for caloric intake than a stable healthy animal. In many exotic species fasting is not advised or limited to only a 3-6 hour fast prior to the anesthetic event. Fortunately many of these same patients are unable to vomit (mice, rats, rabbits, squirrels, beavers, guinea pigs), reducing chances of aspiration. Ferrets and shrews do have the ability to vomit and in these species the limited fast may be indicated.
Antiemetic drugs are available and are relatively safe.

**Recovery:**
The recovery period, unfortunately, does not mean one is out of the woods with intensive monitoring. In fact, a study showed that a majority of small animal anesthetic deaths occurred during recovery within three hours following extubation. Pulling a tube too soon may inhibit proper gas exchange, or the animal may be at risk for aspiration. Keeping the animal warm is one of the other bigger challenges. A common mistake seen in many practices is having the animal exposed. People understandably want to see the animal and assess breathing. Unfortunately, leaving an animal exposed and uncovered increases their chance of becoming hypothermic, unless in a temperature-controlled incubator. Patients after longer anesthetic events may have become hypoglycemic as well and may require glucose supplementation IV or orally. Restarting caloric intake is vital to a successful recovery and prognosis in many small exotic animals. Tube feeding may be indicated in some critical animals, especially if a history of poor appetite or anorexia was present prior to the anesthetic event. Preferably, IV access and fluids will be able to be maintained post-anesthetic event and routine catheter care should be implemented. Appropriate analgesia is crucial in accommodating the patient’s comfort and ability to heal and should never be overlooked.

*References available upon request*