The synthesis of bile acids occurs during the degradation of cholesterol in hepatocytes. Thus, this analyte is expected to be a sensitive indicator of hepatocellular dysfunction or alterations in portal circulation. Bile acids can be quantified via an enzymatic reaction to a highly conserved moiety across species. The evidence for the clinical utility of bile acids for the diagnosis of liver disease is strongest in birds and ferrets with equivocal evidence in rodents, rabbits, and reptiles. Current limitations to the interpretation of bile acids in exotic animal species include a paucity of species-specific reference intervals and incomplete understanding of bile acid metabolism in nonmammalian species and the diversity of bile acids synthesized by vertebrates.

Monitoring blood lactate concentrations with a handheld, point-of-care (POC) meter is an efficient and inexpensive method of monitoring critically ill or anesthetized exotic patients. Serial monitoring of lactate allows early recognition of hypoperfusion, allowing for prompt implementation of resuscitative efforts. Reference ranges for exotic animals are currently sparse and often gathered from field studies of wild animals. In the absence of reference ranges, extrapolations can be made regarding mammals and birds, but may be more difficult in reptiles and amphibians.

Whole blood viscoelastic coagulation testing (VCT) allows global assessment of hemostasis and fibrinolysis. Although not widely used in exotic animal practice, VCT has been used in exotic animal research settings. Differences in patient demographics and analytical variables can result in dramatically different results with the same analyzer. To improve the utility of VCT in exotic animal medicine, standardization of protocols is necessary to facilitate the establishment of reference intervals. Despite these challenges, the quantitative/qualitative nature of VCT has already proved its real-world value to some clinicians.
Hemostatic Testing in Companion Exotic Mammals
Sarrah Kaye and Tracy Stokol

The mammalian hemostatic system is highly conserved, and companion exotic mammals are commonly used as biomedical models for normal and disordered hemostasis. Challenges associated with sample collection, test validation, and test interpretation have limited the use of these tests in clinical exotic animal practice. However, evaluation of platelet counts, coagulation screening times, and fibrin(ogen) degradation products can be valuable for monitoring exotic patients with a range of disease presentations including intoxications, anemia, systemic viral disease, hepatopathy, and endocrinopathy.

Endocrine Diagnostics for Exotic Animals
Susan Fielder and João Brandão

Endocrine disease in exotic species is less common than in small animals. Nevertheless, the diagnostic principles used in small animals can be adapted to evaluate endocrine disease in many of the exotic species although species-specific aspects need to be considered. This article covers important diseases such as thyroid dysfunction in reptiles and birds, hyperthyroidism in guinea pigs, and hyperadrenocorticism in ferrets. Glucose metabolism in neoplasms affecting normal physiology, such as insulinoma in ferrets and gastric neuroendocrine carcinoma in bearded dragons, is discussed. Calcium abnormalities, including metabolic bone disease in reptiles and hypocalcemia in birds, are also covered.

Digital Cytology in Exotic Practice: Tips to Optimize Diagnosis
Richard Dulli and Sabrina D. Clark

Digitization has enhanced the utility of cytology in private practice by allowing for rapid sample receipt and analysis, leading to better informed real-time patient care. Despite many advantages of digital cytology, understanding its limitations is required to avoid common pitfalls. A strong foundation in sample preparation and imaging techniques is also required to obtain high-quality diagnostic samples. By optimizing these factors, the benefits of digital cytology are maximized, allowing for the practice of high-quality point-of-care medicine that best addresses the needs of the patient and pet owner in a rapid time frame.

Select Avian Diagnostic Analytes
Avian Inflammatory Markers
Raquel M. Walton and Andrea Siegel

Inflammation represents a fundamental response to diverse diseases ranging from trauma and infection to immune-mediated disease and neoplasia. As such, inflammation can be a nonspecific finding but is valuable as an indicator of pathology that can itself lead to disease if left unchecked. This article focuses on inflammatory biomarkers that are available and clinically useful in avian species. Inflammatory biomarkers are identified via evaluation of whole blood and plasma and can be divided into acute and chronic, with varying degrees of specificity and sensitivity.
Evaluation of multiple biomarkers may be necessary to identify subclinical disease.

**Blood Lipid Diagnostics in Psittacine Birds**

Hugues Beaufrère

Lipids are the main biomolecular constituents of plasma and occupy a central place in the pathophysiology of several common diseases of parrots. Dyslipidemias frequently occur in psittacine birds in relation to a variety of lipid accumulation disorders and female reproductive disorders. The five main lipid classes in the plasma are sterols, fatty acyls, glycerolipids, glycerophospholipids, and sphingolipids. Most lipids are transported in the blood within lipoproteins. Lipidologic diagnostic tests to characterize dyslipidemias and risk factors of lipid disorders include routine biochemical tests such as cholesterol and triglycerides, lipoprotein testing, and newer comprehensive techniques to assess whole lipid pathways using lipidomics.

**Clinical Pathology Diagnostic Overviews for Select Reptile Species**

**Diagnostic Clinical Pathology of the Bearded Dragon (Pogona vitticeps)**

Clark Broughton and Kyle Lauren Webb

The bearded dragon (Pogona vitticeps), an omnivorous Agamid lizard native to inland Australia, is one of the most popular reptile pets due to their sociable behavior, tame demeanor, low-maintenance care, and relative ease of breeding. Because they are generally stoic animals, thorough physical examination in conjunction with routine clinicopathologic data can prove invaluable in identifying disease and implementing appropriate therapy in a timely manner. The goal of this article is to assist the practicing clinician, based on literature review, on how to approach the diagnostic challenge encountered in everyday practice when working up various conditions in bearded dragons.

**Clinical Pathology of Box Turtles (Terrapene spp.)**

Laura Adamovicz and Matthew C. Allender

Box turtles are commonly presented for veterinary care and clinicopathologic testing is a vital component of case management. This article summarizes recent literature about box turtle clinical pathology and identifies directions for future research.

**Diagnostic Clinical Pathology of Tortoises**

Cheryl Moller and J. Jill Heatley

Clinicopathologic evaluation of terrestrial tortoises is useful for health assessment and monitoring. There are specific considerations when evaluating data from these species, including sex, age, time of year/season, reproductive status, diet, captive versus wild, geographic location, methodology, and anticoagulant. The authors describe sample collection, hematology, biochemistry, and urinalysis features of terrestrial tortoises and discuss clinical relevance.
Freshwater turtles are physiologically unique in their adaptations to life on both land and freshwater habitats. Appropriate interpretation of laboratory values specific to these species is important for both conservation efforts in free-ranging populations and in captive populations, especially because these animals become increasingly popular as pets. Although normal physiology has been well characterized, understanding of clinicopathologic changes in response to disease processes in freshwater chelonian species is relatively limited. This article reviews the current knowledge of hematology, plasma biochemistry, and urinalysis specific to freshwater turtles, with correlates to other chelonian species when specific data are unavailable.

Hematology and biochemistry testing of boas and pythons is a valuable topic for practicing clinicians and researchers alike. This article reviews blood cell morphology (with accompanying images) and reviews the literature for hematologic and biochemical material clinically relevant to the families Boidae and Pythonidae.