

Alphabet Soup: Understanding Comprehensive Metabolic Profiles

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Abstract

A Comprehensive Metabolic Panel (CMP) or Chemistry Panel typically consists of 12 to 20 individual tests within a single run. The primary purpose of a CMP is to evaluate major organ functions—specifically the liver, kidneys, and pancreas—alongside electrolytes, proteins, and glucose. These profiles play a critical role across proactive wellness, emergency situations, and diagnostic medicine.

Blood Sample Collection and Handling

Pre-analytic factors serve as the foundation of reliable diagnostic results. The patient state prior to blood collection can affect the outcome of testing. Fasting status is crucial, as it directly impacts glucose, triglycerides, and certain liver enzyme readings. Patient stress may also play a role, as both cats and dogs are susceptible to stress hyperglycemia.

Hemolysis, or bloody serum, is often caused by forceful aspiration, using a needle that is too small, or freezing and thawing the sample. This results in falsely increased potassium, phosphorus, and liver enzymes. Lipemia is generally caused by drawing blood from a non-fasted patient. Lipemia creates "foggy" results and actively interferes with the light spectrophotometry used by analyzers. Icterus is caused by elevated bilirubin. This condition can interfere with specific assays, including alkaline phosphatase (ALP), total protein, creatinine, and lipase.

Tube Selection & Handling

The order of blood drawing is important to prevent cross-contamination of the additives in the tubes. The first tube to be drawn should be the sodium citrate (Blue Top) for coagulation assays, followed by the Lithium Heparin (Green Top). This tube utilizes an anticoagulant mechanism that inhibits thrombin, allowing for the separation of plasma. It provides the fastest turnaround time and is considered the gold standard for chemistry panels.

However, lithium heparin binds with calcium and magnesium and may falsely increase CK and GGT. These samples should be centrifuged immediately. Next to be drawn is the Serum Separator Tube (SST / Red Top). These tubes contain an additive to encourage clotting, and SSTs include a gel to separate serum from clotted cells. Samples must rest for 15 to 30 minutes at room temperature prior to centrifugation to ensure complete clotting. After the Serum or SST, the EDTA (Purple Top) is drawn. While excellent for preserving cell morphology, EDTA is not ideal for CMPs because its high concentration of potassium severely interferes with results. Many want to draw this tube prior to the Serum or SST to

prevent clotting, but the EDTA may interfere with testing for metabolic assays. Finally, the Flouride Oxalate (Gray Top) which is used for blood cultures, blood glucose, and lactates.

Regardless of the tube used, serum or plasma must be separated from cells within one hour to prevent cellular leakage and the consumption of glucose.

Key Components of a Metabolic Profile

These values are often best interpreted in a system-based approach. The renal parameters include Blood Urea Nitrogen (BUN), Creatinine (CREA), SDMA (Symmetric Dmethylarginine) and Phosphorus. BUN is a waste product of normal liver function filtered by the kidneys and levels are affected by pre-renal (hydration), renal (damage), and post-renal (obstruction) factors. Creatinine is produced by muscle tissue, and this value is relatively stable and serves as the main marker for Glomerular Filtration Rate (GFR), which is a key indicator of overall renal function. Over 75% of renal function needs to be lost for these values to flag above the normal range, making serial screening assays an important tool to early detection. SDMA is the earliest indicator of kidney function loss; it increases when approximately 25% of function is lost; however, recent studies indicate that it may not be as reliable as previously thought. Phosphorus levels are often elevated in patients with chronic kidney disease as the kidneys lose the ability to excrete excess phosphate from the blood.

The hepatic parameters include alanine aminotransferase (ALT), aspartate aminotransferase (AST), gamma-glutamyl transferase (GGT), alkaline phosphatase (ALKP or ALP), Total Bilirubin, Albumin, and BUN. Hepatocellular Leakage Enzymes indicate cellular damage or injury. ALT is the primary specific marker in dogs and cats, while AST is less specific because it is also found in muscle. Cholestasis / Induction Enzymes indicate issues with bile flow or drug exposure. ALP is highly sensitive in dogs but less reliable in cats, whereas GGT is more specific for biliary disease. Assessing actual hepatic mass and liver function involves evaluating albumin (synthesized by the liver), bilirubin (cleared by the liver), and BUN (which can drop in severe liver failure due to an inability to convert ammonia to urea).

Electrolytes and Pancreas

Potassium (K⁺) is critical for cardiac function. High levels (hyperkalemia) are often seen in blocked cats or Addison's disease, while low levels (hypokalemia) are associated with GI loss or insulin therapy. Calcium (Ca⁺⁺) levels may be elevated in kidney disease, with lower protein levels, with increased parathyroid hormone, urogenital disease, lymphoma, and primary bone disease. Sodium (Na⁺) and Chloride (Cl⁻) levels are often directly tied to hydration. High levels of glucose (GLU) strongly suggest Diabetes Mellitus, though stress

and excitement can cause transient elevations, especially in cats. Amylase & Lipase are exocrine enzymes related to the pancreas; elevations often suggest pancreatitis, with lipase being the more specific marker.

Describing Value to Clients

To improve client compliance, veterinary professionals must successfully translate diagnostic results into client comprehension. Some tips to improving that comprehension include avoiding the use of medical jargon. Instead of using terms like "azotemia" or "hyperbilirubinemia," explain that "the kidneys aren't clearing waste effectively" or "we see jaundice because the liver isn't processing bile". Using visual analogies to compare the kidneys to a clogged filter to explain BUN/CREA backups. When discussing elevated liver enzymes (ALT/ALP), compare them to "spilled contents" from damaged cells rather than implying immediate organ failure. These analogies help clients to understand what is happening inside their pet's bodies. And finally, shift the conversation by focusing on the "why". Explain that these diagnostics offer early disease detection before symptoms appear, ensure safety prior to procedures or medications, allow the team to monitor treatment success, and provide ultimate peace of mind.

Conclusion

The quality of the sample directly dictates the quality of the results. Understanding the pre-analytic factors including patient fasting and stress will directly affect sample outcomes. The collection technique matters. Comprehensive metabolic profiles offer a systemic view of the patient; professionals should look for patterns across multiple values. Clients need to understand that serial testing is necessary to establish accurate health trends over time. Effectively communicating the value to clients builds trust and significantly improves compliance.

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