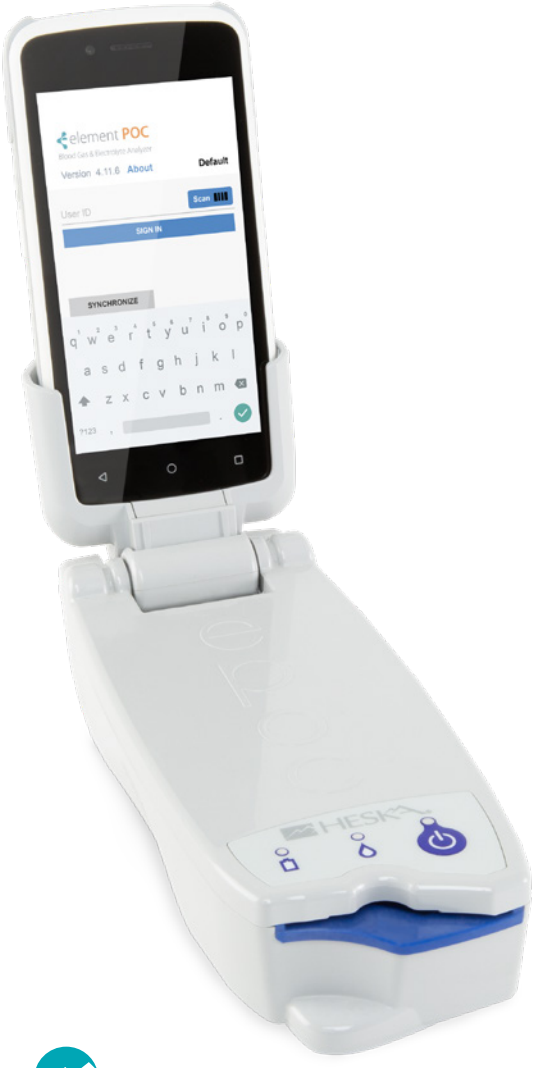
element POC

Blood Gas & Electrolyte Analyzer

Clinical Applications Guide



HESKA

AN ANTECH® COMPANY

Get All of These Parameters on Just One Test Card:

Measured Parameters	
pH	pH
pCO_2	Carbon Dioxide Partial Pressure
pO_2	Oxygen Partial Pressure
TCO_2	Total Concentration of Carbon Dioxide
Na^+	Sodium
K^+	Potassium
Cl^-	Chloride
iCa^{++}	Ionized Calcium
BUN	Blood Urea Nitrogen
Crea	Creatinine
Glu	Glucose
Lac	Lactate
Hct	Hematocrit
Calculated Parameters	
$cHCO_3^-$	Bicarbonate Concentration
BE (ecf)	Base Excess of Extracellular Fluid
AG	Anion Gap
cSO_2	Functional Oxygen Saturation
cHgb	Hemoglobin Concentration

BE PREPARED

- Emergency situations
- Complex medical conditions
- Monitoring

GET RAPID TEST RESULTS IN LESS THAN A MINUTE

- Acid-base and blood gases
- Electrolytes
- Renal function
- Ionized calcium
- Lactate
- Basic chemistries and hematology

ASSESS YOUR PATIENTS

- In the field
- In the exam room
- In the treatment or operating room

The Element POC Blood Gas & Electrolyte Analyzer from Heska advances the speed, versatility and convenience of clinical diagnostics with the advantage of handheld portability.

With less than 100 µl (~ 0.1 ml) of sample, Element POC delivers accurate blood chemistry, electrolyte, hematology, acid-base and blood gas results in less than a minute.

This resource provides a guide to the clinical application of the following:

- E — **ELECTROLYTES:** Sodium, Potassium & Chloride
- iCA — IONIZED CALCIUM
- R — **RENAL:** BUN, Creatinine
- A-B — **ACID-BASE:** pH, Bicarbonate, Total Carbon Dioxide, Base Excess, Anion Gap
- G — GLUCOSE
- L — LACTATE
- B-G — **BLOOD GAS:** Oxygen and Carbon Dioxide
- H — **HEMATOLOGY:** Hematocrit, Hemoglobin

E

ELECTROLYTES

Sodium, Potassium and Chloride

Knowledge of electrolyte disturbance is imperative to further determine and characterize many disorders. In most cases, elevations and decreases of sodium, potassium and chloride are secondary to another disease process (renal disease, endocrine disease, nutritional deficiencies or toxicities) that is affecting organ function in such a way that electrolyte balance is altered.

CLINICAL APPLICATION

Diagnostic and treatment decisions:

- Plan additional tests (*e.g.*, chemistry panel, CBC, urinalysis)
- Fluid type, rate, volume, additives
- Specific medications to shift balance

Monitoring/serial testing:

- Acute imbalances
- Chronic conditions
- Fine tuning fluid therapy
- Drug side effects
- Success of therapy

iCA IONIZED CALCIUM

Measurement of ionized calcium is the most accurate way to diagnose hyper- and hypocalcemia conditions. When testing total calcium levels on standard blood chemistry analyzers, the parameter reflects total body calcium in the bound and unbound forms. Whereas the ionized calcium measured on the Element POC is the unbound, bioavailable form of calcium that is active in metabolic processes and most relevant to the clinical picture.

CLINICAL APPLICATION

Diagnostic and treatment decisions:

- Verify abnormal total calcium measurements
- Plan additional tests (*e.g.*, chemistry panel, CBC, urinalysis, rectal palpation, imaging)
- Calcium gluconate administration
- Fluid type, rate, volume, additives

Monitoring/serial testing:

- Determine chemotherapy remission
- Post-operative condition
- Neoplasia relapse
- Success of therapy

R

RENAL
BUN, Creatinine

Creatinine elevations may reflect pre-renal, renal or post-renal conditions. Renal insufficiency is one of the most common disorders diagnosed in veterinary patients. Due to the functional reserve of the kidneys, affected animals typically do not show clinical signs of chronic renal disease until they have lost nearly 75% of renal function. Patients with renal disorders may present for routine appointments, or in a crisis state that must be immediately diagnosed and addressed.

BUN is a measure of kidney and liver health. Elevated BUN levels can be caused by kidney disease, as well as liver and/or heart disease. Levels can also be affected by a recent feeding and hydration status. BUN and Creatinine should be considered together when evaluating kidney function.

When considered with signalment, history, physical exam findings and comparison to other tests, the BUN and creatinine values provided by the Element POC can help the clinician quickly assess a patient's renal function and state of hydration.

CLINICAL APPLICATION

Diagnostic and treatment decisions:

- Screen renal health
- Confirm hydration status
- Detect renal compromise
- Plan additional tests (*e.g.*, chemistry panel, CBC, urinalysis, imaging)
- Fluid type, rate, volume, additives

Monitoring/serial testing:

- Renal function over time
- Drug side effects
- Success of therapy

IRIS STAGING OF CHRONIC KIDNEY DISEASE (CKD)
(based on plasma creatinine concentration)

Staging is undertaken following diagnosis of CKD in order to facilitate appropriate treatment and monitoring of the patient. There are separate but related algorithms for staging CKD in cats and dogs.

Staging is based initially on fasting plasma creatinine, assessed on at least two occasions in the stable patient. The patient is then substaged based on proteinuria and blood pressure.

Stage	Blood Creatinine (mg/dl)	Comments
At risk	As for Stage 1	History suggests the animal is at increased risk of developing CKD in the future because of a number of factors (*e.g.*, exposure to nephrotoxic drugs, breed, high prevalence of infectious disease in the area, or old age).
1	< 1.4 Dogs	Nonazotemic. Some other renal abnormality present (*e.g.*, inadequate urinary concentrating ability without identifiable nonrenal cause, abnormal renal palpation or renal imaging findings, proteinuria of renal origin, abnormal renal biopsy results, increasing blood creatinine concentrations in samples collected serially).
	< 1.6 Cats	
2	1.4–2.0 Dogs	Mild renal azotemia (lower end of the range lies within reference ranges for many laboratories, but the insensitivity of creatinine concentration as a screening test means that animals with creatinine values close to the upper reference limit often have excretory failure). Clinical signs usually mild or absent.
	1.6–2.8 Cats	
3	2.1–5.0 Dogs	Moderate renal azotemia. Many extrarenal clinical signs may be present.
	2.9–5.0 Cats	
4	> 5.0 Dogs & Cats	Severe renal azotemia. Many extrarenal clinical signs usually are present.

Table used by permission of the International Renal Interest Society.

A-B

ACID-BASE

pH, $cHCO_3^-$, pCO_2, $cTCO_2$, Anion Gap, Base Excess

Knowledge of Acid-Base status allows the clinician to deliver targeted and, in many cases, life-saving intervention.

Excess acid or base ions generated by disease processes can adversely affect the blood pH (normally 7.35–7.45) unless compensated for by renal or respiratory mechanisms.

The relationship between pH, bicarbonate and dissolved carbon dioxide is illustrated with the chart on the next page. Other values to consider are the total carbon dioxide, anion gap and base excess.

Calculated total carbon dioxide is synonymous with bicarbonate in aerobic samples.

Anion gap is a calculated value that equals the unmeasured anions (*e.g.*, lactic acid, ketoacids, salicylic acid, phosphates).

Base Excess indicates whether buffers are being lost, gained or remaining balanced.

CLINICAL APPLICATION

Diagnostic and treatment decisions:

- Plan additional tests (*e.g.*, chemistry panel, CBC, urinalysis, imaging, centesis, trocharization, surgery)
- Fluid type, rate, volume, additives
- Oxygen therapy
- Resuscitation

Monitoring/serial testing:

- Success of treatment
- Trends useful as prognostic
- Anesthesia
- Post-operative condition

As shown in this chart, simple acid-base disturbances can be interpreted based on the relationship between pH, HCO_3^- and pCO_2. These values, coupled with history and physical examination, will help determine if the patient is suffering from a primary metabolic or respiratory process and whether compensation is occurring.

	pH	pCO_2	HCO_3^-	Differential
Metabolic Acidosis	↓	Normal or decreasing*	↓	Diabetes, Addison's, renal failure, increased acid production
Metabolic Alkalosis	↑	Normal or increasing*	↑	Vomiting from upper GI obstruction, administration of alkaline solutions or diuretics
Respiratory Acidosis	↓	↑	Normal or increasing*	Respiratory obstruction, Pneumonia, Mediastinal Disease
Respiratory Alkalosis	↑	↓	Normal or decreasing*	Anemia, CHF, exuberant mechanical ventilation

* If compensation is occurring.

Please refer to Element POC Technical Summaries, *Understanding Acid-Base Data* (#17LT0703) and *Approach to Acid-Base Disturbances* (#17LT0704) for further information.

G GLUCOSE

Extreme highs and lows of blood glucose call for immediate intervention.

Significant elevations are typically due to diabetes mellitus with or without ketoacidosis. Extremely low blood glucose can be idiopathic but is often caused by eclampsia, starvation, hypothermia, insulinoma, septicemia or insulin overdose.

CLINICAL APPLICATION

Diagnostic and treatment decisions:

- Plan additional tests (*e.g.*, chemistry panel, CBC, urinalysis, glucose curve, fructosamine)
- Insulin therapy
- Glucose administration
- Fluid type, rate, volume, additives

Monitoring/serial testing:

- Insulin adjustments
- Glucose curves
- Septic patients
- Success of therapy

L LACTATE

Blood lactate is a by-product of anaerobic glycolysis. Elevated plasma concentration (lactic acidosis) indicates some degree of metabolic derangement.

The most common causes of elevated lactate are hypoperfusion secondary to shock or GDV and hypoxia due to severe anemia or asthma.

Lactate is most informative when serial measurements are evaluated. If your patient's lactate level decreases, prognosis is better than if levels stay the same or rise.

Value mmol/L	Interpretation
0.22–1.44	Normal
3–5	Mild systemic hypoperfusion
5–10	Moderate hypoperfusion
>10	Severe hypoperfusion

CLINICAL APPLICATION

Diagnostic and treatment decisions:

- Plan additional tests (*e.g.*, chemistry panel, CBC, imaging)
- Degree of stomach necrosis in GDV
- Limb viability in feline aortic thromboembolism
- Oxygen delivery
- Fluid type, rate, volume, additives

Monitoring/serial testing:

- Trends for prognostic indicator
- Track fitness in horses
- Success of therapy

B-G

BLOOD GAS

pO_2, pCO_2, sO_2

Arterial blood gas analysis measures the pressure exerted by dissolved oxygen and carbon dioxide (pO_2, pCO_2) and is the industry standard for assessing respiratory function. Only a small amount of oxygen is dissolved in the plasma (pO_2). The majority is attached to hemoglobin and is the saturated oxygen (sO_2), which can also be measured by a pulse oximeter.

Sampling of venous blood can be used for carbon dioxide measurement, with a separate set of normal values, but is of no value for assessing oxygen levels.

CLINICAL APPLICATION

Diagnostic and treatment decisions:

- Oxygen delivery
- Stability for surgical intervention
- Anesthetic protocol
- Intubation
- Tracheotomy
- Manual ventilation
- Fluid type, rate, volume, additives

Monitoring/serial testing:

- Anesthesia in high risk patients
- Thoracotomy
- Major abdominal procedures
- Adjust supplemental oxygen
- Success of therapy

Visual assessment of a patient's mucous membrane color and capillary refill time can sometimes be misleading, since "pink" does not always reflect adequate oxygenation, as outlined in the chart below.

The following table interprets mucous membrane color as it relates to PaO_2 and SpO_2 from a pulse oximeter.

Mucous Membrane Color	PaO_2 mmHg	SpO_2 %	Interpretation	Action
Pink	80–100	90–100	Normal	None
Pink	75–80	85–90	Mild hypoxemia	Provide supplemental O_2
Dark Pink to Purple	~ 60	~ 80	Severe hypoxemia	Provide supplemental O_2
Cyanotic	< 40	< 75	Extreme hypoxemia	Provide supplemental O_2

Readily accessible arteries for sample collection are the lingual, femoral, and dorsal pedal (large dogs).

Please refer to Element POC Technical Summary, *Arterial Blood Sampling* (#17LT0705) for further information.

H

HEMATOLOGY
Hct, cHgb

Knowledge of red blood cell percentage and oxygen carrying capacity provides important information for guiding diagnostic and treatment decisions.

Anemia is common in both acute and chronic disorders and depending on the rate and duration of blood loss, emergency measures may be indicated. Elevations of hematocrit are also important in assessing hydration and disorders such as polycythemia.

CLINICAL APPLICATION

Diagnostic and treatment decisions:

- Plan additional tests (*e.g.*, chemistry panel, CBC, imaging)
- Oxygen therapy
- Blood product administration
- Fluid type, rate, volume, additives

Monitoring/serial testing:

- Trend anemia over time
- Success of therapy

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Call 800.464.3752 for free case consultations, technical support or more information on how the Element POC Analyzer supports your patient diagnosis and treatment protocols.