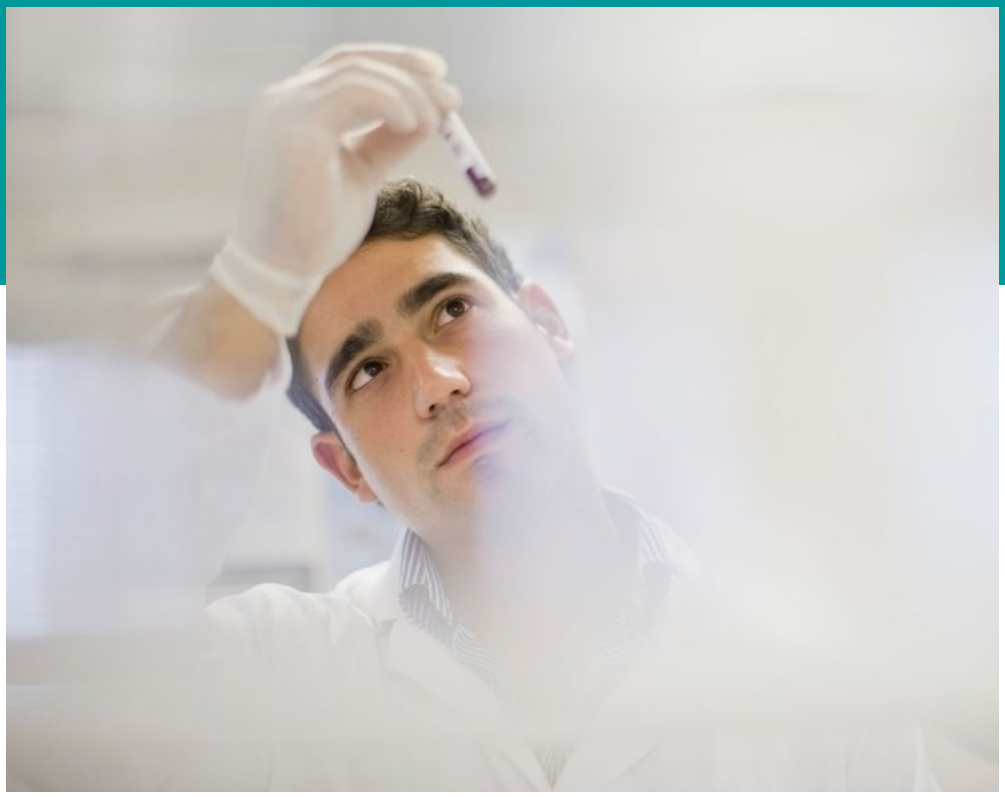
Clinical Insights

Lactate: a critical analyte

Enabling critical decision making at the point of care



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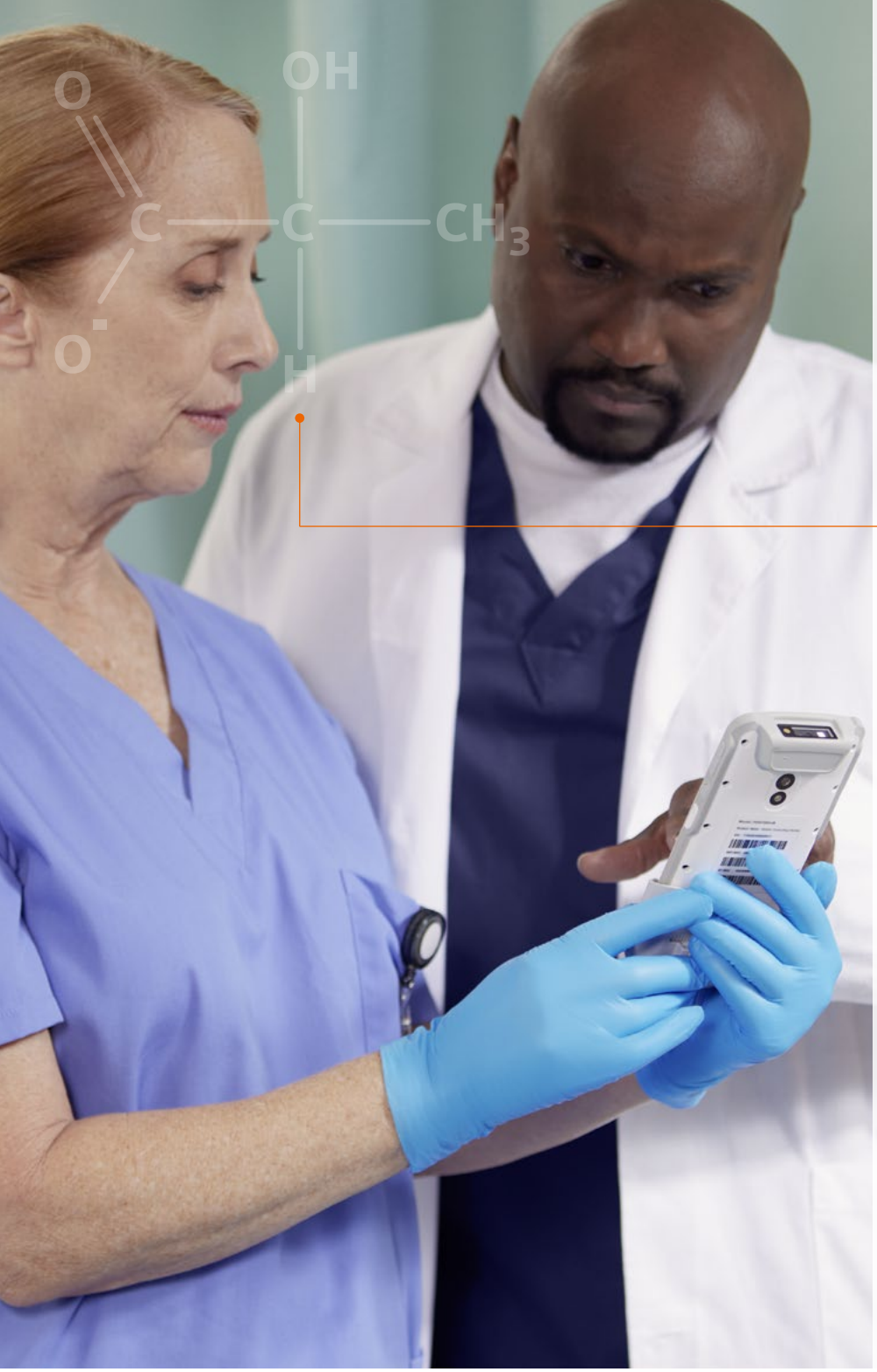


What is lactate?[1,2]

Lactate is the end-product of glucose metabolism (breakdown of carbohydrates to produce energy) and a waste product of anaerobic metabolism (energy production without oxygen). In an acidic environment, lactate takes the form of lactic acid.

Normal lactate levels are
less than 2 mmol/L.

Lactate is produced in excess by muscle cells, red blood cells, brain, and other tissues when there is insufficient oxygen at the cellular level (hypoxia) or when the primary way of producing energy in the body's cells is disrupted. Excess lactate can lead to hyperlactatemia.

Hyperlactatemia is defined as lactate levels
between 2 and 4 mmol/L.

Patients with hyperlactatemia may also have reduced blood pH (acidosis). The combination of hyperlactatemia and acidosis is called lactic acidosis.

Lactic acidosis is defined as lactate levels of
4 mmol/L or higher.

What is the clinical significance of lactate?[1]

Lactic acidosis is among the most common concerns for those caring for critically ill patients, and early diagnosis and intervention are critical for positive patient outcomes.

- High levels of lactate are associated with increased risk of death independent of organ failure and shock.
- Patients with mildly elevated and intermediate levels of lactate, along with sepsis, have higher rates of in-hospital 30-day mortality.

A number of conditions can cause elevated lactate levels.
They are separated into two groups, **Type A and Type B**, according to the mechanism by which they cause lactic acidosis (LA).[4]

Type A results from an imbalance between tissue oxygen supply and demand (hypoxia).

Type A (clinical evidence of tissue hypoxia)[4]
Shock (cardiogenic, **septic**, hypovolemic)
Regional hypoperfusion (limb, mesenteric)
Severe hypoxemia
Severe anemia

Symptoms of hypoxia[3]

- Shortness of breath
- Rapid breathing
- Paleness
- Sweating
- Nausea
- Muscle weakness
- Abdominal pain
- Coma

Type B is lactic acidosis that occurs when clinical evidence of poor tissue perfusion or oxygenation is absent (no hypoxia).[4]

Type B (no clinical evidence of tissue hypoxia)[4]		
Type B1 (LA with an underlying disease)	**Type B2** (LA due to drugs or toxins)	**Type B3** (LA due to inborn errors of metabolism)
Diabetes	Ethanol	Glucose-6-phosphatase deficiency
Liver disease	Methanol	Fructose-1,6-diphospatase deficiency
Malignancy	Ethylene glycol	Pyruvate carboxylase deficiency
Sepsis	Propylene glycol	Pyruvate dehydrogenase deficiency
	Salicylates	
	Acetaminophen	

Did you know?[5-7]

Sepsis is:

- The body's extreme response to an infection.
- A life-threatening condition and a global disease burden.
- The primary cause of death from infection, a leading cause of death in hospitals, and a main cause of hospital readmittance.

Included as a CMS Core Measure:

- Severe Sepsis and Septic Shock: Management Bundle (Composite Measure) v5.13. Objective reduction in healthcare-associated infections.

Lactate measurement is:

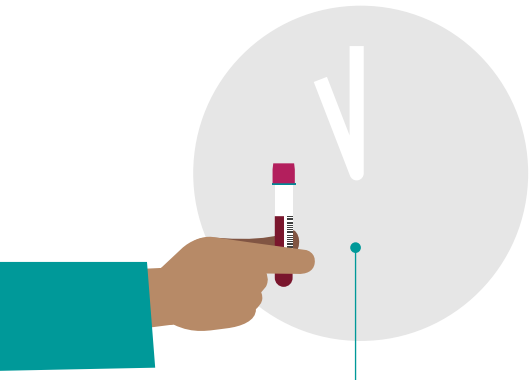
- Part of the Surviving Sepsis Campaign Guidelines.

Early recognition is crucial to the recovery of the sepsis patient, and lactate plays an important role in the diagnosis of sepsis.

Blood lactate is a valuable laboratory analyte because it:

- Can detect tissue hypoxia and developing shock early in their appearance,
- Provides prognostic information by giving a semiquantitative estimate of oxygen deficit,
- Helps with differential diagnosis, ***and***
- Helps to monitor and direct resuscitation therapy.[4]

The importance of lactate testing



Early recognition of elevated lactate levels may hasten the detection of time-sensitive illness.

In fact, blood lactate, as an indicator of metabolic acidosis, can serve as a single marker for immediate medical intervention. Lactate can be measured from both venous and arterial blood.[2,3] However, after blood is drawn, RBC metabolism continues to generate lactate, particularly if significant delays exist before analysis.[8] **This clinical hurdle can be overcome with point-of-care, patient-side lactate testing.**

Point-of-care testing can provide accurate, efficient, and timely lactate measurements with the potential to influence clinical decision making sooner.[8,9]

Testing locations[10-13]

Emergency room[10,11]

- Patients may present with the following symptoms: nausea, rapid breathing, muscle weakness, rapid breathing, vomiting, coma.
- Increased levels of lactate should prompt immediate diagnostic and therapeutic measures.

Intensive care unit[10,11]

- Elevated lactate levels indicate tissue hypoxia, which can lead to organ failure.

Operating room[12]

- Blood lactate is a strong predictor of mortality, and repeated blood lactate assays are recommended during surgery in high-risk patients.

Emergency medical services (EMS)[13]

- Lactate testing in the field enables earlier identification of sepsis and administration of antibiotics on the scene, leading to better patient outcomes.

Rapid measurements of blood lactate at the point of care may be used for:

- Admission, early treatment, and triage decisions in the emergency department (acute myocardial infarction, trauma, sepsis, and occult illness),
- Ensuring adequate oxygen delivery to the tissues in the operating room (high-risk surgeries), ***and***
- Monitoring circulatory shock in the intensive care unit (post-surgery, trauma, heart failure, sepsis, transfusion adequacy, and burns).[14]

Point-of-care lactate testing

In critically ill patients, lactate concentrations are reported to correlate well with disease state, have prognostic value, and can be used for monitoring.[11] As lactate is a valuable parameter in the early resuscitation of critically ill patients, rapid results are often needed for effective patient management.[15]

The use of POCT lactate measurements represents an attractive option to obtain a fast result on a small volume of blood.[16]

Lactate: 9 Key Points

A marker of emerging or critical illness associated with increased morbidity and mortality

1. Any condition that interferes with the delivery of oxygen to the tissues will cause the lactate blood level to rise.
2. A number of conditions can cause elevated lactate levels and lactic acidosis.
3. High levels of lactate are associated with increased risk of death independent of organ failure and shock.
4. Patients with mildly elevated and intermediate levels of lactate, along with sepsis, have higher rates of in-hospital 30-day mortality.
5. Sepsis is the primary cause of death from infection, a leading cause of death in hospitals, and a main cause of hospital readmittance.
6. Lactate measurement is part of Surviving Sepsis recommendations **AND** sepsis is included as a CMS Core Measurement.
7. Lactate measurements are commonly performed in the ED, ICU, OR, and EMS.
8. **After blood is drawn, RBC metabolism continues to generate lactate.** Delays before analysis may result in inaccurate assessment of patient lactate levels.
9. ***Point-of-care lactate testing can provide accurate, efficient, and timely measurements with the potential to influence clinical decision making sooner.***

Summary

In critically ill patients, lactate concentrations are reported to correlate well with disease state, have prognostic value, and can be used for monitoring.[11] **As lactate is a valuable parameter in the early resuscitation of critically ill patients, rapid results are often needed for effective patient management.**[15] **The use of POCT lactate measurements represents an attractive option to obtain a fast result on a small volume of blood.**[16]

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POCT

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Educational support provided by Siemens Healthineers.

All information is for education only and is not intended to be relied upon by the reader for instruction as to the practice of medicine.

Any healthcare practitioner reading this information is reminded that they must use their learning, training, and expertise in dealing with their individual patients.

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