

Division of Laboratory Medicine

Biochemistry

Bicarbonate

Pseudonyms – TCO₂, total bicarbonate

Bicarbonate is used as an indicator of acid-base status in venous samples. Together with pH determination (<https://mft.nhs.uk/the-trust/other-departments/laboratory-medicine/a-z-list-of-laboratory-tests/#acidbase>) bicarbonate measurements are used in the diagnosis and treatment of numerous potentially serious disorders associated with acid-base imbalance in the respiratory and metabolic systems.

Bicarbonate is the second largest fraction of the anions in plasma. Included in this fraction are the bicarbonate (HCO₃⁻) and carbonate (CO₃²⁻) ions, as well as the carbamino compounds. At the physiological pH of blood, the concentration of carbonate is 1/1000 that of bicarbonate. The carbamino compounds are also present in such low quantities that they are generally not mentioned specifically.

This is included in a standard renal profile, paediatric U/E and paediatric full profile. A separate request for bicarbonate must be made in adult patients if they are not under the care of a renal clinician.

General information

Collection container:

Adults – serum (with gel separator, 4.9mL brown top Sarstedt tube)

Paediatrics – lithium heparin plasma (1.2mL orange top Sarstedt tube)

Type and volume of sample: The tubes should be thoroughly mixed before transport to the lab. 1mL whole blood is required as a minimum volume. Ideally the tube should be filled to prevent redistribution of bicarbonate as reduced levels are observed in samples with low blood volume.

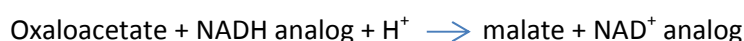
Specimen transport/special requirements: N/A

Laboratory information

Method principle: Bicarbonate reacts with phosphoenolpyruvate (PEP) in the presence of PEP Carboxylase to produce oxaloacetate and phosphate:



The above reaction is coupled with one involving the transfer of a hydrogen ion from NADH analog to oxaloacetate using malate dehydrogenase (MDH).



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The resultant consumption of NADH analog causes a decrease in absorbance, which is proportional to the concentration of bicarbonate in the sample being assayed.

Biological reference range or cut off: 19-28 mmol/L

Turnaround time: Same day as sample receipt

Clinical information

Factors known to significantly affect the results:

This test is **not** significantly affected by lipaemia, icterus or haemolysis.

Delay in processing the sample can cause artefactually low values.

Discrepancies can arise between the total bicarbonate level reported on a venous sample compared to actual bicarbonate reported on a blood gas instrument.

Clinical decision points:

When evaluating bicarbonate levels, the result should be interpreted in terms of losses (renal, intestinal), or an acute compensatory response to an acidosis. Changes in potassium levels are often frequently observed, usually hypokalaemia in alkalosis and hyperkalaemia in acidosis.

Some of the causes of a low bicarbonate level include:

- Addison's disease <https://labtestsonline.org.uk/conditions/adrenal-insuficiency-and-addisons-disease>
- Chronic diarrhoea <https://labtestsonline.org.uk/conditions/diarrhoea>
- Diabetic ketoacidosis <https://labtestsonline.org.uk/glossary/ketoacidosis>
- Metabolic acidosis <https://labtestsonline.org.uk/conditions/acidosis-and-alkalosis>
- Kidney disease <https://labtestsonline.org.uk/conditions/kidney-disease>
- Alcohol poisoning
- Salicylate (aspirin) overdose <https://labtestsonline.org.uk/tests/salicylate>
- Proximal Renal Tubular Acidosis

Increased levels may be due to:

- Severe vomiting
- Lung diseases, including chronic obstructive pulmonary disease (COPD) <https://labtestsonline.org.uk/conditions/lung-diseases>
- Cushing's or Conn's syndrome <https://labtestsonline.org.uk/conditions/conns-syndrome>
- Metabolic alkalosis <https://labtestsonline.org.uk/conditions/acidosis-and-alkalosis>

References:

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<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5849971/> Understanding Acid-base Disorders

[https://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(98\)03087-6/fulltext](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(98)03087-6/fulltext) Acid-base (one of an electrolyte quintet)

(Last updated January 2020)