CONDITION

# Acidosis

Learn how acidosis affects the body's acid-base balance, including its symptoms, causes, diagnosis, treatment, complications, and follow-up care.

**WHAT IT IS**
Process that lowers blood pH

**BODY SYSTEM**
Whole body

**MAIN SYMPTOMS**
Deep rapid breathing, nausea or vomiting, tiredness or weakness, confusion

**WHAT CAUSES IT**
Underlying illnesses, medicines, or toxins

**HOW IT IS DIAGNOSED**
Blood gas and blood chemistry tests

**MAIN TREATMENT**
Underlying-cause treatment and supportive care

**CAN IT BE CURED?**
Sometimes - when underlying cause is treated

**IS IT AN EMERGENCY?**
Sometimes - severe trouble breathing or new confusion

**LONG-TERM OUTLOOK**
Depends mainly on cause and speed of onset

## Overview

Acidosis is a process that adds too much acid to the body or removes too much bicarbonate, a substance that helps neutralize acid. It can also occur when the lungs cannot remove enough carbon dioxide. Carbon dioxide acts like an acid when it builds up in the blood.

The body normally keeps blood acidity within a narrow range. This is measured with a value called pH . The lungs help control pH by removing carbon dioxide. The kidneys help by removing acids in urine and returning bicarbonate to the blood.

Doctors use related terms that have slightly different meanings:

A person may have more than one acid-base problem at the same time. The lungs and kidneys can also compensate for a problem by adjusting carbon dioxide or bicarbonate levels. This may

move the pH closer to normal, but it does not remove the underlying cause.

Acidosis matters because severe changes in pH can interfere with the heart, brain, muscles, and other organs. Some causes develop quickly and require emergency treatment. Others develop slowly, such as acidosis related to chronic kidney or lung disease, and are managed through regular medical care.

- Acidosis is a process that pushes blood pH downward.
- Acidemia means the measured blood pH is below the usual range.
- Metabolic acidosis usually results from acid buildup, bicarbonate loss, or reduced acid removal by the kidneys.
- Respiratory acidosis develops when breathing does not remove enough carbon dioxide.

## Symptoms

Symptoms depend on the cause, how quickly the acidosis developed, and how much the pH has changed. Mild or slowly developing acidosis may cause few noticeable symptoms.

Metabolic acidosis may cause:

Respiratory acidosis may cause:

These symptoms are not specific to acidosis. Blood tests are needed to determine whether an acid-base problem is present.

Seek emergency care for severe trouble breathing, blue or gray lips, new confusion, inability to stay awake, a seizure, collapse, or suspected poisoning or drug overdose. A person with diabetes also needs urgent assessment for vomiting, abdominal pain, deep rapid breathing, marked drowsiness, or high glucose with elevated ketones, according to their diabetes care plan.

- Deep, rapid breathing as the lungs try to remove more carbon dioxide
- Nausea, vomiting, or loss of appetite
- Tiredness or weakness
- Headache
- Confusion or reduced alertness
- Symptoms of the underlying illness, such as diarrhea, fever, or increased thirst and urination
- Shortness of breath or slow, shallow breathing

- Headache, especially after waking
- Sleepiness or difficulty staying awake
- Confusion
- Restlessness or anxiety
- Tremor or muscle twitching

## Causes and risk factors

Metabolic acidosis

Metabolic acidosis has several major patterns.

Lactic acidosis occurs when lactate builds up faster than the body can clear it. This may happen when tissues are not receiving enough blood or oxygen, such as during shock, severe infection, cardiac arrest, or major blood loss. Seizures, intense muscle activity, liver problems, and certain medicines can also contribute.

Ketoacidosis results from the buildup of acids called ketones. Diabetic ketoacidosis can occur when the body does not have enough effective insulin. Ketoacidosis may also be associated with prolonged lack of food, heavy alcohol use with poor nutrition, or other serious illness.

Reduced kidney acid removal can occur with acute kidney injury or chronic kidney disease. The kidneys may be unable to remove the body's daily acid load or maintain enough bicarbonate.

Bicarbonate loss can result from severe or prolonged diarrhea. Certain kidney conditions, including renal tubular acidosis, can also cause bicarbonate loss or interfere with acid removal.

Medicines and toxic substances may cause metabolic acidosis through different pathways. Examples include some diabetes medicines in particular clinical settings, salicylate poisoning, toxic alcohols such as methanol or ethylene glycol, and medicines that alter kidney handling of bicarbonate. The specific pattern depends on the substance.

Doctors often divide metabolic acidosis into high and normal anion gap forms. The anion gap is a calculation based on electrolyte test results. A high gap suggests that unmeasured acids, such as lactate, ketones, or certain toxins, have accumulated. A normal gap more often points to bicarbonate loss or a problem with kidney acid handling.

Respiratory acidosis

Respiratory acidosis occurs when ventilation-the movement of air into and out of the lungs-is not adequate to remove carbon dioxide.

Possible causes include:

Risk depends on the underlying cause. People with kidney disease, diabetes, severe infection, chronic lung disease, neuromuscular disease, or exposure to certain medicines or toxins may be more likely to develop an acid-base disturbance. Having one of these risk factors does not mean that acidosis is present.

- Chronic obstructive pulmonary disease, particularly during a flare
- Severe asthma or another major airway obstruction
- Severe pneumonia, fluid in the lungs, or advanced lung disease
- Opioids like oxycodone or morphine , sedatives, anesthesia, or other substances that slow breathing
- Conditions affecting breathing muscles or nerves
- Chest wall disorders that limit lung expansion
- Obesity hypoventilation syndrome
- Brain injury or other conditions affecting control of breathing
- Problems with a mechanical ventilator or airway

## Diagnosis

Acidosis is diagnosed through clinical assessment and laboratory testing. A healthcare professional will ask about symptoms, medical conditions, recent illness, medicines, supplements, alcohol or substance use, and possible toxic exposures.

A blood gas test measures pH, carbon dioxide, and bicarbonate. An arterial blood gas uses blood from an artery and also provides detailed information about oxygen levels. In some situations, a venous blood gas can provide useful pH and carbon dioxide information with a simpler blood draw.

Blood chemistry tests usually measure bicarbonate and electrolytes such as sodium, potassium, and chloride. These results help calculate the anion gap. Kidney function and glucose are also commonly checked.

Further tests depend on the suspected cause. They may include:

Doctors interpret these findings together. A low bicarbonate level alone does not always prove metabolic acidosis. Likewise, a high carbon dioxide level must be considered alongside the pH, bicarbonate level, symptoms, and whether the change appears acute or chronic.

The expected response of the lungs or kidneys can help identify a second acid-base disorder. For example, a person may have both metabolic acidosis and respiratory acidosis if severe

illness affects the kidneys, circulation, and breathing at the same time.

- Blood lactate
- Blood or urine ketones
- Complete blood count and tests for infection
- Liver tests
- Urinalysis
- Electrocardiogram to assess heart rhythm
- Chest imaging or lung function assessment
- Toxicology tests or levels of specific substances
- Osmolality testing when a toxic alcohol exposure is possible

## Treatment and management

Treatment focuses on the cause and the severity of the acid-base disturbance. Mild chronic acidosis may be managed through outpatient care, while severe or rapidly developing acidosis often requires treatment in a hospital.

For metabolic acidosis, treatment may include:

Sodium bicarbonate may be used in certain forms of bicarbonate loss, chronic kidney disease, or severe acidemia. It is not a routine treatment for every case. Bicarbonate can add sodium and fluid, change potassium or calcium levels, and produce carbon dioxide. Clinicians weigh these effects against the likely benefit and monitor treatment with repeat laboratory tests.

Respiratory acidosis is treated by improving ventilation and addressing what is limiting breathing. This may involve airway-opening medicines for obstructive lung disease, treatment of infection, reversal of a medication effect when an appropriate antidote exists, or support for weak breathing muscles.

Some people need noninvasive ventilation through a tight-fitting mask. Others may need a breathing tube and mechanical ventilation. Oxygen may also be required when the blood oxygen level is low, but oxygen alone does not remove excess carbon dioxide.

People with chronic respiratory acidosis can develop kidney compensation over time. Treatment is therefore guided by the full clinical picture rather than by a single carbon dioxide result. Changes in ventilatory support may need to be made gradually and monitored closely.

- Fluids and treatment of poor circulation when appropriate

- Insulin, fluids, and careful electrolyte monitoring for diabetic ketoacidosis
- Treatment of infection and support of blood pressure in sepsis
- Management of diarrhea or another source of bicarbonate loss
- Adjustment of a medicine that is contributing to the problem
- An antidote or enhanced removal of a toxic substance when available
- Dialysis or another form of kidney replacement therapy in selected cases
- Management of chronic kidney disease and its complications

## Complications

The outlook depends more on the cause and speed of onset than on the label of acidosis alone. When severe, acidemia can reduce the heart's ability to pump, lower blood pressure, and contribute to abnormal heart rhythms. Potassium levels may rise or shift quickly, which can further affect the heart and muscles.

Severe acidosis may also impair the response to medicines used to support blood pressure. Brain effects can include confusion, profound drowsiness, seizures, or coma.

Long-standing metabolic acidosis related to chronic kidney disease may contribute to muscle loss, bone problems, and worsening kidney function. Chronic respiratory acidosis can be a sign of ongoing ventilatory failure and may worsen during infections, medication changes, or sleep.

Complications can often be reduced by treating the underlying condition, reviewing medicines, and monitoring laboratory results when clinically appropriate.

## Follow up

Follow-up depends on why the acidosis occurred. After an acute episode, a clinician may repeat electrolyte, bicarbonate, kidney function, glucose, ketone, or blood gas tests to confirm that the problem has resolved.

Routine follow-up may include:

Do not stop a prescribed medicine solely because it is listed as a possible contributor. A clinician can assess the medicine's benefits, the circumstances in which risk may increase, and whether an alternative is appropriate.

Contact a healthcare professional promptly for worsening shortness of breath, repeated vomiting or diarrhea, increasing weakness, unusual sleepiness, or difficulty controlling glucose

or ketones. Emergency symptoms include severe breathing difficulty, new confusion, inability to wake normally, seizure, collapse, blue or gray discoloration, or a suspected overdose or toxic exposure.

- Reviewing medicines and supplements
- Monitoring kidney or lung disease
- Checking bicarbonate and potassium levels
- Updating a diabetes sick-day and ketone-testing plan
- Discussing nutrition when kidney disease, alcohol use, or poor intake contributed
- Planning how to recognize and respond to recurrence

## Sources


- Berend K, de Vries APJ, Gans ROB. Physiological approach to assessment of acid-base disturbances. New England Journal of Medicine . 2014;371(15):1434-1445.
- Kraut JA, Madias NE. Metabolic acidosis: pathophysiology, diagnosis and management. Nature Reviews Nephrology . 2010;6(5):274-285.
- Jung B, Rimmele T, Le Goff C, et al. Diagnosis and management of metabolic acidosis: guidelines from a French expert panel. Annals of Intensive Care . 2019;9:92.
- Kidney Disease: Improving Global Outcomes. KDIGO 2024 Clinical Practice Guideline for the Evaluation and Management of Chronic Kidney Disease. Kidney International . 2024;105(4S):S117-S314.
- Merck Manual Professional Edition. "Metabolic Acidosis" and "Respiratory Acidosis." Merck & Co., Inc. Accessed February 28, 2025.
- U.S. National Library of Medicine. "Diabetic Ketoacidosis." MedlinePlus Medical Encyclopedia . Accessed February 28, 2025.