What propylene glycol is and where it is present

Propylene glycol is a dissolving agent and carrier utilized in a number of medical and nonmedical products. In clinical settings, it is most important because it can appear in **IV medications**, especially certain sedatives and other formulations that need a liquid base. It can also be included in some **oral products** and **topical products**. Most exposures are harmless, but large or prolonged exposure can create a **toxicity** problem, especially in hospitalized patients.

This matters because propylene glycol is not just an ingredient; it is a compound that is *metabolized* by the body into other substances. Under the right situations, those **metabolites** can affect acid-base balance and lead to abnormal serum chemistry findings. In some patients, the clinical picture includes **high anion gap** findings, especially when the exposure is significant or renal clearance is impaired.

From a diagnostic assessment standpoint, propylene glycol exposure is often overlooked unless the medication list is reviewed closely. That is why laboratory interpretation must be paired with clinical correlation. The product source, route of exposure, and duration all influence whether propylene glycol becomes clinically relevant.

How the anion gap is calculated

The **anion gap** is a derived value used to assist in identifying certain types of **metabolic acidosis**. It represents the variation between tested cations and measured anions in the blood. The standard **anion gap formula** uses **serum sodium**, **serum chloride**, and **serum bicarbonate**.

A simplified version is:

anion gap = serum sodium − (serum chloride + serum bicarbonate)

An **anion gap calculator** simplifies this calculation and can support users see whether the result sits in a normal interval or indicates an acid-base imbalance. Because the result is based on the measured electrolyte values, even small electrolyte variations can change the number.

The anion gap is important because unmeasured anions can build up in the blood during conditions such as lactic acidosis, ketoacidosis, or toxin ingestion. When interpreting the number, clinicians also consider **albumin**, since low albumin can decrease the measured gap and hide a clinically important disturbance. That is why the **albumin-corrected anion gap** is often more revealing than the unadjusted value.

Why propylene glycol can increase the anion gap

Indeed, propylene glycol can lead to a **high anion gap** in the setting of **propylene glycol toxicity**. The mechanism is anion gap in chronic kidney disease usually not direct rather than instant. After exposure, propylene glycol is metabolized into acidic compounds, including **organic acids**, which can contribute to **high anion gap metabolic acidosis**. In addition, the body may develop a coexisting **lactic acidosis**, which additionally increases the gap.

Another important clue is the **osmolar gap**. Propylene glycol itself increases serum **osmolarity**, so early toxicity may present with an elevated osmolar gap before the anion gap rises. As metabolism proceeds, the parent compound decreases while acidic **metabolites** collect, shifting the pattern from isolated osmolar gap elevation to a combined osmolar gap and high anion gap presentation.

This progression is why the point in time of testing matters. A patient may initially have a high osmolar gap and later show worsening acidosis, elevated lactate, and a rising anion gap. In other words, propylene glycol can be part of a mixed laboratory pattern that develops over time.

Common causes of high anion gap metabolic acidosis

Propylene glycol remains one possible explanation of **metabolic acidosis**. A wide **differential diagnosis** is crucial whenever the anion gap is elevated. Common causes include **ketoacidosis**, **lactic acidosis**, **renal failure**, and ingestion of **toxic alcohols**. All of these can cause a similar lab pattern, but the underlying mechanism is different.

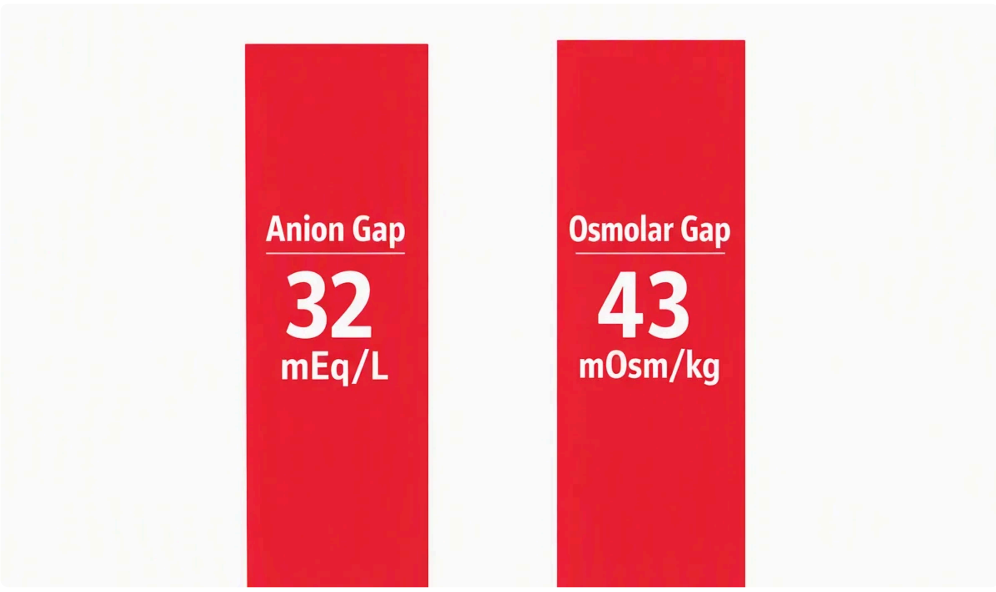
Ketoacidosis is often seen with diabetes, starvation, or prolonged vomiting, while lactic acidosis may occur with shock, sepsis, hypoperfusion, or certain drugs and toxins. Renal failure can raise the gap because the kidneys cannot clear acid effectively, allowing unmeasured acids to accumulate. Toxic alcohols, such as methanol or ethylene glycol, can also produce an elevated anion gap and osmolar gap pattern.

That is why laboratory interpretation should never rely on a single number alone. The anion gap calculator can identify a concerning result, but the final diagnosis depends **MUDPILES mnemonic explanation** on the clinical context, medication exposure, and additional testing.

Signs and signs of propylene glycol toxicity

The manifestations of **propylene glycol toxicity** can be vague at first. Patients may experience **altered mental status**, **hypotension**, and **tachypnea** as the acid-base imbalance worsens. Tachypnea often indicates respiratory compensation for acidosis. Some patients may also display signs of worsening perfusion or sedation, depending on the total exposure and the drugs involved.

A rising **serum lactate** can be an important clue, especially when the clinical picture suggests an unexplained acid-base disorder. Elevated lactate does not prove propylene glycol as the cause, but it increases suspicion when combined with medication exposure, abnormal serum chemistry, and a high anion gap. Because the findings overlap with other illnesses, **clinical correlation** is critical.



Severe cases can progress quickly, particularly when the patient has impaired clearance or multiple risk factors. A careful review of medications, infusion history, and serial labs is often the quickest way to recognize the problem.

Tests used to evaluate suspected toxicity

If propylene glycol exposure is suspected, the evaluation usually includes **serum osmolality**, determination of the **osmolar gap**, a **blood gas**, and evaluation of **renal function**. These measures help determine whether the patient has a blended toxic-metabolic presentation.

Serum osmolality is compared with the calculated osmolarity to identify an osmolar gap. A widened gap suggests unmeasured osmotically active substances, which may include propylene glycol or other toxic alcohols. The blood gas helps define the severity of the acid-base disorder and shows whether the patient has metabolic acidosis with respiratory compensation. Renal function testing is important because reduced clearance can worsen toxicity and prolong exposure.

Further laboratory tests often include serum lactate, electrolytes, and repeat chemistry panels. Serial testing can show whether the anion gap is rising or resolving after intervention. In many patients, the pattern of serum chemistry abnormalities provides the strongest evidence before specialized toxin levels are available.

How to read an Anion Gap Calculator finding

An **anion gap calculator** is valuable, but the finding should always be interpreted in relation. First, check whether the value is in the **normal range** for the lab used. Normal ranges can shift somewhat depending on the analyzer and whether potassium is included in the formula. A result that is borderline in one lab may be obviously abnormal in another.

Afterward, evaluate the possibility of hypoalbuminemia. As **albumin** is a major unmeasured anion, low albumin can mask a true **acidosis**. An **albumin-corrected anion gap** gives a improved estimate of the underlying acid burden when albumin is reduced. This adjustment is particularly helpful in critically ill patients, where albumin is often low.

Finally, ask whether the result corresponds to the overall picture. A high anion gap with normal lactate and normal ketones may suggest a toxin, while a high gap with elevated lactate may suggest tissue hypoperfusion, sepsis, or propylene glycol toxicity. Good interpretation depends on **clinical context**, not just the number.

When exposure to propylene glycol becomes dangerous

Danger grows with **toxicity that depends on dose**, extended exposure, and limited ability to eliminate the compound. This is especially relevant with some **benzodiazepines** and other **intravenous medications** that contain propylene glycol as a solvent. Ongoing or high-dose **infusion** can cause buildup over time.

Renal impairment raises risk because the kidneys are essential in eliminating the compound and its byproducts. If renal clearance is reduced, propylene glycol and its metabolites may build up, leading to osmolar gap elevation, lactic acidosis, and high anion gap metabolic acidosis.

Risk peaks when multiple factors stack together: high medication dose, prolonged infusion, critical illness, dehydration, and impaired kidney function. In that setting, monitoring should be closer and clinicians should stay highly alert for toxicity.

Treatment and management of suspected propylene glycol toxicity

The first step in management is **discontinuation** of the suspected source. Stopping the offending medication or exposure can avoid more accumulation. Depending on the severity of the case, the patient may also need **supportive care**, including fluid resuscitation, correction of electrolyte abnormalities, and treatment of acidosis.

Monitoring is important after the exposure is stopped. Serial serum chemistry testing, blood gas assessment, serum lactate, and renal function checks help show whether the acid-base disorder is improving. If the patient has severe symptoms, rapidly worsening acidosis, or significant renal dysfunction, intensified treatment may be needed.

Hemodialysis can be considered in severe cases because it helps remove propylene glycol and correct associated metabolic derangements. It may be especially useful when there is significant acidosis, hemodynamic instability, or impaired renal clearance. The decision is based on the full clinical picture rather than the anion gap alone.

When to obtain immediate medical evaluation

Immediate evaluation is advised if there are **critical warning signs** such as progressive confusion, severe weakness, breathing difficulty, collapse, or evidence of shock. A patient with suspected **toxic exposure** and a quickly evolving condition should not wait for scheduled review.

Worrisome findings include **severe acidosis**, extremely low bicarbonate, persistent hypotension, or rapidly increasing lactate. These findings may signal a serious acid-base disorder that needs prompt treatment. If propylene glycol exposure is possible, a rapid **medical assessment** can clarify whether the patient needs hospital monitoring, medication changes, or hemodialysis.

As the disorder can overlap with other causes of high anion gap metabolic acidosis, clinicians should evaluate the whole picture early. Rapid assessment of medication exposure, serum osmolality, blood gas results, and renal function can prevent delays in care.

Frequently asked questions about propylene glycol and the anion gap

Can propylene glycol cause a high anion gap?

It can. Propylene glycol can cause a **high anion gap**, especially when exposure is marked or prolonged. It may first raise the **osmolar gap** and then, as it is metabolized into acidic **metabolites**, contribute to **high anion gap metabolic acidosis** and **lactic acidosis**.

What is the difference between an anion gap and an osmolar gap?

The **anion gap** represents unmeasured charged particles and helps identify causes of **metabolic acidosis**. The **osmolar gap** shows the difference between measured and calculated **osmolarity** and suggests unmeasured dissolved substances, such as propylene glycol or other **toxic alcohols**. Both are important, but they serve different questions.

Which medications contain propylene glycol?

Propylene glycol can be found in some **intravenous medications**, including certain **benzodiazepines**, sedatives, and other formulations that use it as a solvent. It may also appear in some **oral products** and **topical products**. The exact formulation depends on the drug and manufacturer, so the medication list should be examined closely.

What signs may indicate propylene glycol toxicity?

Possible signs include **confusion**, **decreased blood pressure**, **rapid breathing**, and signs of increasing acidosis. A elevated **serum lactate** may also be present. As these findings are non-specific, they must be evaluated with exposure history, lab results, and total clinical correlation.

How is propylene glycol toxicity treated?

Therapy usually starts with **discontinuation** of the source and **supportive care**. Clinicians monitor the patient closely with repeat labs, including blood gas, serum chemistry, and renal function. In critical cases, **hemodialysis** may be used to help remove the toxin and correct severe acidosis.