

Updated review of Sodium Correction Rate in Hyponatremia and Hypernatremia

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Evidence to Action: Official Journal of MDCalc

Vol. 012026, Issue 01, 2026

Article Information

Keywords: Sodium Correction Rate for Hyponatremia, hyponatremia, na rate, sodium rate, sodium hyponatremia, seizure sodium, sodium, seizure sodium calc, sodium volume correct, sodium volume, sodium volume calc, hyponatremia calc, hyponatremia fix, hyponatremia treat, hyponatremia tx

<https://doi.org/10.65357/001c.158150>

Submitted: November 07, 2025 EDT

Accepted: February 08, 2026 EDT

Published: March 01, 2026 EDT

I. HOW TO USE

When to Use

When managing patients with hyponatremia or hypernatremia this calculator estimates the rate by type of intravenous fluid to achieve desired correction.

Pearls / Pitfalls

- In most cases, sodium correction for severe hyponatremia (typically defined as serum sodium <120 mEq/L) should be done in an inpatient setting, and under the guidance of expert physicians in this field such as those specializing in nephrology and critical care. Hypertonic fluids for severe, symptomatic hyponatremia requires intensive care setting due to need for frequent sodium monitoring and the risk of overcorrection.
- The proper rate of correction of hyponatremia is important and should be determined through review of current guidelines before using this calculator. Excessively rapid correction can lead to long-term adverse outcomes such as osmotic demyelination syndrome (ODS) with excessively rapid correction of chronic hyponatremia.

Abstract

Hypo- and hypernatremia are common electrolytes abnormalities encountered in clinical practice characterized by abnormal serum osmolality. After a thorough evaluation of the etiology, management in a subset of patients with hypo- and hypernatremia can involve use of hyper- or hypotonic fluids, respectively, to safely correct osmolality towards normal range. This calculator will provide rate of infusion of various types of fluids for desired correction rates. Several caveats must be noted prior to use of this calculator. First, the management of severe hypo- and hypernatremia should involve expert physicians and often requires ICU level of care. Second, rate of correction based on current guidelines must be determined prior to using this calculator as excessively rapid correction could lead to severe, long-term adverse consequences such as osmotic demyelination syndrome (ODS) from excessively rapid correction of chronic hyponatremia. Third, this calculator does not account for other fluid intake and output, and assumes these to be nil. Thus, this calculator is merely a starting point for fluid type and rate selection but no substitute for frequent monitoring of serum sodium.

- This calculator does not account for fluid losses such as in urine and through sweat and respiration. It also does not account for intake through other sources (e.g., oral, other IV fluids). Finally, the underlying formula is accurate for 1 liter of volume infused and may have lower accuracy with greater volumes. Thus, it is important to monitor serum sodium level frequently to ensure that it is correcting appropriately

Why to Use

Determining rate of IV fluids for treatment of hyponatremia and hypernatremia is important

II. NEXT STEPS

Advice

- Correct chronic hyponatremia carefully.
- Monitor sodium level frequently particularly when correcting severe hypo or hypernatremia to assess impact of therapy
- Do not forget to correct the hyponatremia level in hyperglycemic patients with the Sodium Correction for Hyperglycemia calculator and use the corrected sodium for determining treatment goals.

- Typically, hypertonic solutions are reserved for patients who are overtly symptomatic, such as those with seizures and severe neurologic deficits and should be conducted in an ICU setting under the guidance of expert physicians.

Management

- Administer recommended intravenous fluid rate with careful and frequent monitoring of serum sodium as well as accurate recording of intake and output. Adjust fluid rate depending on response in serum sodium levels. Expert guidance is highly recommended for severe hypo- and hypernatremia.

Critical Actions

- Determine appropriate rate of correction of hyponatremia based on clinical scenario
- Chronic hyponatremia should be corrected slowly
- Rapid correction might be necessary for severe hyponatremia with mental status changes
- Monitor serum sodium level frequently and adjust therapy accordingly
- Consider ICU monitoring for severe hyponatremia particularly when prescribing hypertonic fluids
- This calculator does not account for fluid losses such as in urine and through sweat and respiration. It also does not account for intake through other sources (e.g., Oral or IV drips)

III. EVIDENCE

Evidence Appraisal

This tool provides infusion rate of intravenous fluids of various tonicity when correcting tonicity disorders, specifically hyponatremia and hypernatremia. Serum sodium disorders are one of the most common problems in the hospital. This tool is a starting point in determining what fluids should be administered. However, it should be emphasized that there is no substitute for close monitoring of serum sodium levels when managing severe hypo- or hypernatremia. The rate of correction is under debate, particularly for hyponatremia. However, most expert guidelines suggest correction chronic hyponatremia (i.e., duration >48 hours) no greater than 6-8 mEq/L per 24 hours. In some circumstances such as seizure or altered mental status, a short, rapid correction may be appropriate.

The formula is derived from this manuscript:

<https://pubmed.ncbi.nlm.nih.gov/10824078/>

Adrogué HJ, Madias NE. Hyponatremia. *N Engl J Med.* 2000;342(21):1581-1589.

The evidence is a review paper that provides a generally accepted rate of fluid infusion based on sex, age, and weight. This is generally acceptable in the field (given av-

erages of total body water by these variables). There has not been empiric testing of the accuracy of this formula – i.e., infusing a certain amount of a certain tonicity fluid changes serum sodium by a certain amount. Moreover, clinical scenarios often change rapidly making frequent monitoring of serum sodium critical. This tool is easy to use, the variables are easily available. The rates are generally well accepted by experts even though these are not empirically tested.

In severe chronic hyponatremia, experts recommend correcting no faster than 6-8 mmol/L/day (0.5mmol/L/hr) to avoid osmotic demyelination syndrome (ODS), previously known as central pontine myelinolysis (CPM). In cases where more rapid correction is indicated (e.g., seizures), use of hypertonic (3%) saline is indicated to rapidly correct serum sodium by 4-6 meq/L to resolve symptoms and then revert to the slower rate of correction.

Literature

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