

Infusionslösungen 2026

Zusammensetzung und Deklaration

Die „Klinische Physiologie“ (Physioklin) plädiert seit 20 (!) Jahren für eine optimale Zusammensetzung plus Deklaration von Infusionslösungen, d.h., immer nach dem logischen physiologischen **Iso-Konzept** – gleiche Zusammensetzung wie das Plasma oder die Extrazellulär-Flüssigkeit – isotonisch (Natrium, Kalium, Calcium, Magnesium und Chlorid), iso-hydrisch (BEpot) und iso-ton (Osmolalität).

Die englischen Zitate im Literaturverzeichnis sollen dies belegen: Beginnend mit 2006 [1], danach 2022 in einer Publikation von 11 internationalen Autoren mit einer Conclusion [2], gefolgt von einem ausführlichen Booklet in 2023 [3]. Dann anschließend folgt 2024 die erforderliche Definition des potentiellen Base Excess (mmol/L) [4], ein Leserbrief [5] und 2025 die Definition der Osmolalität (mosmol/kg H₂O) [6, 7].

Als Empfehlung bleibt 2026 festzuhalten:

Nicht geeignet sind – zum Beispiel – hyperchlorämische Lösungen wie 0,9 % NaCl, Tutofusin (Baxter); hypotone Lösungen wie 5 % Glukose (reines Wasser), Ringer-Laktat, Plasmalyte (Baxter), Jonosteril (Fresenius Kabi Deutschland) oder auch alkalisierende (nicht iso-hydrische) Lösungen wie ELO-MEL isoton (Fresenius Kabi Austria).

Literatur

1. Rolf Zander

Infusion fluids: Why should they be balanced solutions?

[EJHP Practice 2006](#); 6: 60-62

In this article, the author makes the case for a better description of infusion fluids and their composition. Therefore, the electrolytes (mmol/L) should amount to Na 142 ± 4 , K 4.5 ± 0.5 , Ca 2.5 and Mg 1.25. Ideally, a balanced solution has a Cl of 103 ± 3 mmol/L, but this is difficult to achieve in practice.

The osmotic activity of an infusion fluid is described in terms of its osmolality or osmolarity. A balanced infusion fluid is isotonic if it has the same actual osmolality as plasma (288 ± 5 mosmol/kg H₂O) or the same theoretical osmolarity of a physiological (isotonic) NaCl solution of 308 mosmol/L. What counts is the osmolality that is effective in vivo rather than that measured in vitro. Dextrose 5% in water is clearly isotonic in vitro, but its in vivo effect is that of pure water because glucose rapidly

enters the intracellular space to be metabolised.

The BEpot (mmol/L - in analogy to the BE of blood - indicates the amount of HCO_3 that can potentially be released in the body after infusion and metabolism of anions. This value is obtained by adding BE (with a negative sign) in mmol/L to the sum of metabolisable anions, taking account of their valency.

The BEpot, - recommended for infusion solutions in 1993 - is actually accepted for labelling crystalloid and colloid solutions by pharmaceutical companies in Germany.

2. Friedrich Mertzluft, Franz Brettner, George J. Crystal, Markus W. Hollmann, Anton Kasatkin, Per-Arne Lönnqvist, Dominique Singer, Robert Sümpelmann, Volker Wenzel, Rolf Zander and Thomas Ziegenfuß
Intravenous fluids: issues warranting concern
[Eur J Anaesthesiol 2022](#); 39: 388-407

In conclusion, we recommend strongly that the medical community take Lönnqvist's appeal ('time for a solution') seriously, and urge medical companies and manufacturers to provide improved infusion solutions that are physiologically composed and balanced (Table 1), and which include clear and detailed guidance for their safe and effective use. We believe that these relatively simple steps, which can be achieved without increasing costs, will have a substantial clinical benefit in reducing morbidity and potentially saving lives.

3. Rolf Zander stellt das Booklet [Fluid Management](#) auch als PDF (2023) zur Verfügung.

A balanced solution that has the physiological electrolyte pattern of plasma in terms of sodium, potassium, calcium, magnesium and chloride and their relative contributions toward osmolality, and a physiological acid-base balance achieved with metabolizable anions to replace bicarbonate, confers the following benefits:

- The same balanced solution could be used as a crystalloid or a colloid solution for fluid replacement or volume replacement, respectively.
- Infusion of such a balanced solution will - except in terms of volume produce no iatrogenic disruptions of the electrolyte balance, in particular no hyperchloremia with renal vasoconstriction and decreased diuresis, and hence no overhydration with compartment syndrome and weight gain for several days.
- After infusion and anion metabolism, a solution with a BEpot of 0 ± 10 mmol/L has no effect on the patient's acid-base balance and, therefore, can cause neither acidosis nor alkalosis nor dilutional acidosis, an iatrogenic disorder caused by bicarbonate dilution in the entire extracellular space.

- Acetate has a number of significant advantages over other metabolizable anions, especially over lactate, which should no longer be used as a metabolizable anion.

4. Rolf Zander

Base Excess (BE): reloaded

[Eur J Med Res 2024](#); 29: 281

Conclusion

The optimal requirement for clinically practicable diagnostics is: Kiss, i.e., Keep It Simple and Safe. The Base excess BE (mmol/L) is such a *diagnostic tool* in vivo. Additional, the potential base excess (BEpot, mmol/L) as an *therapeutic tool* in vitro for any infusion solution or blood product indicates the amount of bicarbonate that can potentially be released in the body after infusion or transfusion related to the metabolism of anions.

5. Friedrich Mertzluft, Rolf Zander, George J. Crystal

Letter to the Editor

The choice of resuscitation fluids - Ionic composition matters

[Intensive Care Med 2024](#)

We included recommendations to intravenous fluid manufacturers for compositional information on labels of intravenous solutions:

Iso-tonic (osmolality in mosmol/kg H₂O) instead of (osmolarity in mosmol/L);

Iso-hydric (potential base excess (BEpot), mmol/L), instead of pH or titration acidity;

Iso-ionic (sodium, potassium, chloride in mmol/L) instead of (g/L);

Acetate instead of lactate in mmol/L.

6. Rolf Zander, Thomas Ziegenfuß, Robert Sümpelmann

Osmolality (mosmol/kg H₂O) versus osmolarity (mosmol/L): applied physiology to improve patient safety

[Eur J Med Res 2025](#); 30: 1227

Severe osmotic pressure imbalances may be associated with substantial morbidity and mortality. As a consequence, osmolality should be a routine parameter in clinical medicine, but actual clinical practice often looks different, and confusion or inaccurate interpretations are common. The use of osmolality (mosmol/kg H₂O) instead of osmolarity (mosmol/L) is recommended for clinicians to avoid potentially misleading results when comparing solutions with different water contents. The manufacturers of infusion solutions should present the calculated actual osmolality instead of the theoretical osmolarity in the Summaries of Product Characteristics

to provide a reliable foundation for clinical practitioners. To avoid unwanted water shifts, intravenous fluids for replacement of extracellular fluid or plasma should be isotonic with a calculated actual (in vivo) osmolality of 280 to 300 mosmol/kg H₂O. Hypoosmolality is almost always caused by low sodium concentrations, and recent evidence suggests that slower rates of correction are associated with increased mortality compared to rapid correction.

7. [Appendix](#) - to No 6 - with Examples of publications with wrong or inconsistent units for or definitions of osmolarity, osmolality or tonicity.

This appendix includes 21 publications of different authors with wrong or inconsistent units over 10 years (2014 to 2024).