



Opinion

# How to Adjust the Sodium Concentration in Dialysate Individually and Practically?

Jingjing Zhang

Division of Nephrology, Department of Medicine, Thomas Jefferson University Hospital, Philadelphia, PA 19107, USA; Jingjing.zhang@jefferson.edu

**Abstract:** The optimal dialysate sodium concentration for chronic hemodialysis patients remains controversial. Conflicting data from small observational studies and large cohort study data have not convinced nephrologists to choose either a high or low sodium dialysate. Despite a lack of evidence, I would prescribe individualized dialysate sodium concentrations for patients with a risk of hypertension or volume overload, aligning the dialysate sodium concentration with patients' predialysis serum sodium level. The concentration of dialysate sodium would usually be 0–2 mEq/L below the patient's serum sodium concentration. I believe that this strategy would help improve hypertension, intradialytic weight gain, cardiac outcomes, and deliver precision medicine.

**Keywords:** dialysate sodium; sodium gradient; serum sodium level; individualized



**Citation:** Zhang, J. How to Adjust the Sodium Concentration in Dialysate Individually and Practically? *Kidney Dial.* **2021**, *1*, 161–163. <https://doi.org/10.3390/kidneydial1020023>

Academic Editors: Manfred Hecking, Peter Kotanko and Jochen G. Raimann

Received: 7 September 2021

Accepted: 22 November 2021

Published: 14 December 2021

**Publisher's Note:** MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



**Copyright:** © 2021 by the author. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

**Specific Aim:** “You are being put in charge as the Medical Director of a newly built dialysis clinic in your country. In consideration of available resources and reimbursement policies, how would you prescribe the dialysate sodium concentration for your patients? What would your approach be and why?”

I would advocate three steps in prescribing the dialysate sodium concentration for patients in my dialysis clinic.

First, choose a default dialysate sodium concentration of 138 mEq/L for all new patients. Irrespective of the price of dialysate fluids with different sodium concentrations in United States, I would prescribe a default dialysate sodium concentration of 138 mEq/L for all new patients, because most patients' serum sodium concentration is relatively constant [1,2], averaging around this number [3,4].

I would not align the dialysate sodium concentration with the patient's serum sodium concentration, when just starting dialysis, given that the patient's serum sodium concentration varies when measured at different volume states. The patients will be able to adjust their salt and fluid intake to reach their own natriuretic set point [4]. It is easier for the dialysis unit to routinely start a new patient, with a dialysate sodium concentration of 138 mEq/L.

Second, after three months, I would assess each patient. For high-risk patients, I would individualize the dialysate sodium concentration by aligning it with the patients' predialysis serum sodium concentration.

Clinicians will assess each patient's serum sodium concentration, blood pressure (BP) and volume status during the monthly unit rounds. With continuous education about a low sodium diet and fluid restriction, they will adjust the estimated dry weight (EDW) for each patient. Optimization of the dialysate sodium prescription has been shown to be an important step in achieving sodium balance, improving BP control in hypertensive hemodialysis patients [2], and improving inter-dialytic weight gain (IDWG) [5]. I would therefore utilize individualized dialysate sodium concentrations for specific patients who have issues with volume overload.

Three months after starting hemodialysis in our unit, I would review all the data related to each patient's BP. For patients who have problems with BP, IDWG, or post-

dialysis weight above dry weight, I would lower the dialysate sodium concentration to 0–2 mEq/L below the serum concentration, with a minimum dialysate sodium concentration of 135 mEq/L. Details are shown in the paper published in Hemodialysis International [6]. The rationale for this is to have a neutral sodium gradient during dialysis, which means no sodium diffusing through the dialysis membrane, to avoid extra sodium loading [7,8]. Setting the dialysate sodium concentration approximately 2 mEq/L below the serum sodium concentration is considered to be a neutral gradient.

Varying the dialysate sodium concentration gradient with the patient's serum sodium concentration has different effects on BP and IDWG [5,9]. Therefore, individualized dialysate sodium concentrations are recommended [2,3,10].

Third, maintenance of the dialysate sodium concentration prescription.

Every three months, I would assess each patient's volume status, BP, IDWG, post-dialysis weight versus EDW, and serum sodium concentration. For patients who have evidence of hypertension, high IDWG, or fail to reach EDW, I would further adjust the dialysate sodium concentration if needed, and address sodium and fluid restriction.

The DOPPS (the Dialysis Outcomes and Practice Patterns Study) data, showing that patients with lower serum sodium who are dialyzed with a higher sodium dialysate concentration have a lower mortality, are intriguing [11]. However, multiple studies suggest the hyponatremia itself is associated with increased risk of death [12–14]. I am more concerned that loading more sodium on patients during hemodialysis will worsen hyponatremia. I would keep most patients on a lower dialysate sodium concentration once prescribed. I have not observed more intra-dialytic hypotension in our unit after lowering the dialysate sodium concentration. I do increase the dialysate sodium concentration up to 138 mEq/L if a patient becomes hypotensive, with no sign of volume overload, as some frail patients may benefit from a higher dialysate sodium concentration [11,15]. Most importantly, I would not prescribe a dialysate sodium concentration below 135 mEq/L [6].

**Conclusions:** With the above strategy, the dialysis unit would be able to focus on those patients with volume issues. A consensus on these procedures is needed among all providers in the unit. The medical director should intermittently educate the nurses and technicians about the effect of dialysate sodium on the patients and how to pay special attention to the individualized prescription every time that they place the patient on the dialysis machine.

I believe that this strategy would deliver precision medicine, reduce hospitalization, and improve cardiovascular outcomes, eventually leading to economic benefit.

**Funding:** This research received no external funding.

**Institutional Review Board Statement:** Not applicable.

**Informed Consent Statement:** Not applicable.

**Data Availability Statement:** Not applicable.

**Conflicts of Interest:** The author declares no conflict of interest.

## References

1. Peixoto, A.J.; Gowda, N.; Parikh, C.R.; Santos, S.F. Long-term stability of serum sodium in hemodialysis patients. *Blood Purif.* **2010**, *29*, 264–267.
2. Santos, S.F.; Peixoto, A.J. Revisiting the dialysate sodium prescription as a tool for better blood pressure and interdialytic weight gain management in hemodialysis patients. *Clin. J. Am. Soc. Nephrol.* **2008**, *3*, 522–530.
3. Flanigan, M.J. Role of sodium in hemodialysis. *Kidney Int. Suppl.* **2000**, *76*, S72–S78.
4. Hecking, M.; Kainz, A.; Horl, W.H.; Herkner, H.; Sunder-Plassmann, G. Sodium setpoint and sodium gradient: Influence on plasma sodium change and weight gain. *Am. J. Nephrol.* **2011**, *33*, 39–48.
5. Raimann, J.G.; Ficociello, L.H.; Usvyat, L.A.; Zhang, H.; Pacelli, L.; Moore, S.; Sheppard, P.; Xiao, Q.; Wang, Y.; Mullon, C.; et al. Effects of dialysate to serum sodium (Na<sup>+</sup>) alignment in chronic hemodialysis (HD) patients: Retrospective cohort study from a quality improvement project. *BMC Nephrol.* **2018**, *19*, 75.

6. Ramaswamy, K.; Brahmabhatt, Y.; Xia, J.; Song, Y.; Zhang, J. Individualized dialysate sodium prescriptions using sodium gradients for high-risk hemodialysis patients lowered interdialytic weight gain and achieved target weights. *Hemodial. Int.* **2020**, *24*, 406–413.
7. Flanigan, M.J. How should dialysis fluid be individualized for the chronic hemodialysis patient? *Sodium. Semin Dial.* **2008**, *21*, 226–229.
8. Lomonte, C.; Basile, C. Do not forget to individualize dialysate sodium prescription. *Nephrol. Dial. Transplant.* **2011**, *26*, 1126–1128.
9. Munoz Mendoza, J.; Sun, S.; Chertow, G.M.; Moran, J.; Doss, S.; Schiller, B. Dialysate sodium and sodium gradient in maintenance hemodialysis: A neglected sodium restriction approach? *Nephrol. Dial. Transplant.* **2011**, *26*, 1281–1287.
10. Arramreddy, R.; Sun, S.J.; Munoz Mendoza, J.; Chertow, G.M.; Schiller, B. Individualized reduction in dialysate sodium in conventional in-center hemodialysis. *Hemodial. Int.* **2012**, *16*, 473–480.
11. Hecking, M.; Karaboyas, A.; Saran, R.; Sen, A.; Horl, W.H.; Pisoni, R.L.; Robinson, B.M.; Sunder-Plassmann, G.; Port, F.K. Predialysis serum sodium level, dialysate sodium, and mortality in maintenance hemodialysis patients: The Dialysis Outcomes and Practice Patterns Study (DOPPS). *Am. J. Kidney Dis.* **2012**, *59*, 238–248.
12. Mc Causland, F.R.; Brunelli, S.M.; Waikar, S.S. Dialysate sodium, serum sodium and mortality in maintenance hemodialysis. *Nephrol. Dial. Transplant.* **2012**, *27*, 1613–1618.
13. Waikar, S.S.; Curhan, G.C.; Brunelli, S.M. Mortality associated with low serum sodium concentration in maintenance hemodialysis. *Am. J. Med.* **2011**, *124*, 77–84.
14. Nigwekar, S.U.; Wenger, J.; Thadhani, R.; Bhan, I. Hyponatremia, mineral metabolism, and mortality in incident maintenance hemodialysis patients: A cohort study. *Am. J. Kidney Dis.* **2013**, *62*, 755–762.
15. Marshall, M.R.; Dunlop, J.L. Are dialysate sodium levels too high? *Semin. Dial.* **2012**, *25*, 277–283.