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Impact of Dialysate Flow Reduction on the Carbon Footprint of Hemodialysis

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Objectives : As part of our institutional efforts to address environmental issues, we examined strategies to reduce dialysate flow rates. We previously reported that in post-dilution online hemodiafiltration (HDF), solute removal performance is maintained even when the total dialysate flow rate (Q_{D_total}) is reduced from 500 to 350 mL/min. This study evaluated the extent to which reducing Q_{D_total} contributes to CO_2 emission reduction.
Methods : The impact of Q_{D_total} reduction was evaluated by comparing electricity consumption, water use and wastewater treatment volume, and dialysate consumption at Q_{D_total} values of 500 and 350 mL/min. The CO_2 emission was calculated using annual consumption and CO_2 emission factors. Electricity consumption related to dialysate flow in dialysis machine was estimated by simulation, while water use, wastewater treatment volume, and dialysate consumption were calculated from annual measured data at our institution.
Results : Electricity consumption related to dialysate flow was 8.5 t-CO_2 (22,584 kWh) at Q_{D_total} 500 mL/min and 6.0 t-CO_2 (15,834 kWh) at 350 mL/min. Water use and wastewater treatment were 12.3 t-CO_2 (6,468 m³) at 500 mL/min and 7.9 t-CO_2 (4,116 m³) at 350 mL/min. CO_2 emissions associated with production of dialysate concentrates were 56.6 t-CO_2 (A concentrate: 20,240 L; B concentrate: 25,500 L) at 500 mL/min and 42.9 t-CO_2 (A concentrate: 15,000 L; B concentrate: 18,900 L) at 350 mL/min. Overall, reducing Q_{D_total} from 500 to 350 mL/min reduced emissions by 0.20 t-CO_2 per patient per year and 20.8 t-CO_2 per year for the facility. This corresponds to the annual CO_2 emissions of about 10 average households in Japan.
Conclusions : Reducing the total dialysate flow rate from 500 to 350 mL/min while maintaining solute removal performance reduced CO_2 emissions by 0.20 t-CO_2 per patient per year and 20.8 t-CO_2 annually at the facility level.