Centre for Sustainable Delivery

NHS SCOTLAND

National Green Renal Programme

pròg ram dubhaig uaine nàiseanta

Introduce Incremental Haemodialysis

January 2026

An opportunity to save across NHS Scotland:

98 tonnes of CO_2e per year

£6,250 per patient year

1. Description of action

1.1 To implement a protocol of personalised, incremental haemodialysis, adapted to local parameters.

2. Background, and opportunity for change

2.1 Haemodialysis (HD) is traditionally initiated with a fixed 3 times weekly regimen, based on historic studies of patients with little residual kidney function (RKF).[1] 'Dialysis-free time' is a top priority for patients,[2] yet inflexible dialysis prescribing can lead to overtreatment, accelerated loss of RKF, and unnecessary environmental and financial impact.[3] Incremental haemodialysis (iHD) offers a personalised and sustainable alternative: starting with a reduced dialysis prescription and increasing as clinically indicated.

2.2 iHD is evidenced by observational studies and Randomised Control Trials (RCTs).[4, 5, 6, 7] Although formal clinical practice guidelines aiding the implementation of iHD are lacking, both the 2015 National Kidney Foundation's Kidney Disease Outcomes Quality Initiative (KDOQI) 'Clinical Practice Guideline for Haemodialysis Adequacy' and Renal Association Haemodialysis Guidelines note that dialysis requirement may be lower if residual kidney function remains,[8, 9, 10] Further guidance for setting up a local protocol is available in the 'How-to' guide, and in review articles.[11]

3. Who needs to be involved in this change locally?

3.1 In order to implement this action it is recommended that the following groups should be consulted and involved:

- Ensure labs can analyse, and report 24hr urine collection volume and urea.
- Ensure dialysis unit nurses are confident in managing iHD patients: providing urine collection bottle, to be returned and sent to lab for volume and urea measurement to coincide with monthly pre- and post-HD bloods. Also in avoidance and immediate correction of intra-dialytic hypotension.
- Explore if IT can integrate formulae to automatically generate weekly combined StKt/V i.e. a dialysis adequacy report, ideally with safety checks included; if not, provide staff with calculator to input numbers themselves (see 'How-to' guide).
- Know how patients will be easily identifiable as 'iHD' on their electronic record and on dialysis paperwork. Ensure this is standardised, and ideally can facilitate searches for 'all iHD patients' to improve ease of monitoring.
- Have patient information leaflet or video of the principals of iHD ready for discussion with potential patients.
- Involve transport schedulers, particularly if 3 patients dialysing in 2 slots.
- Engage the team - present clinical and sustainability evidence; align with patient goals; invite feedback and discussion.

4. Boundaries

4.1 The table below identifies the boundaries for this action:

In scope	Out of scope
– Consumables – Dialysis machine energy use – Patient travel (excluding ambulance travel) – Clinical waste management N.b. Validation CO2e estimate (Appendix 1) is based on wider boundaries; also including equipment manufacture, heating and lighting, staff and patient travel, all waste management; pharmaceutical manufacture and distribution (where possible), water supply and plant energy.	– Home HD differences not accounted for – Access creation and maintenance – Shared hospital resources e.g. laundry, car park, catering, portering, etc – Waste water treatment – End of life of plant/dialysis equipment – Equipment manufacture – IT hardware – Dialysis delivered for emergency indications or in critical care – Decremental dialysis* – Patient transport by ambulance – Travel (staff) – Dialysate and water usage – non-clinical waste – Heating and lighting of RDU

* Similar benefits, but monitoring and approach to care differ, and beyond the scope of this Opportunity for Change.

5. What are the potential co-benefits of this change?

5.1 Patient related

The main benefits of iHD are fewer dialysis treatments and better quality of life of new HD patients.[2] There is no additional mortality risk, and hospital admissions may be fewer (relative risk = 0.31; 95% CI 0.18–0.54). [7, 12] Data from observational studies (but not RCTs) suggest maintaining urine output and preserving RKF may reduce complications of end stage kidney disease (ESKD), including intradialytic hypotension, and anaemia; iron and erythropoetin stimulating agent requirement may be less. [7] Fewer cannulations of the patients' arteriovenous graft may increase longevity of vascular access, and less accessing central venous catheters (CVC) may reduce bacteraemia rates, particularly in the highest risk period of the first 3 months.[13]

5.2 Potential benefits of preserving RKF

iHD may confer Quality of Life (QoL) and survival benefit through more stable fluid and electrolyte balance and a greater removal of middle molecules, based on evidence suggesting preserved RKF.[1, 12, 14, 14] Evidence is mixed, but iHD is certainly non-inferior.[15] Preservation of RKF in iHD may mostly relate to fewer episodes of intradialytic hypotension; further minimised through focus on immediate correction of any episodes of hypotension and hypovolaemia on HD. [1, 10]

5.3 Service delivery and environmental co-benefits

In addition to the patient-related benefits above, financial costs, service demand, and carbon equivalents are reduced.[7, 16] The latter due to reduced travel, energy use, dialysis consumables, pharmaceuticals, and waste generated by a typical HD treatment.

Outcome	Potential Benefits
Carbon reduction	98 tCO2e per year (restricted boundaries/scope), up to 459 tCO2e per year (wide boundaries/scope, see Appendix 1).
Cost savings	£6,250* saving per patient year spent on iHD. [16]
Patient experience	Better QoL, fewer dialysis treatments, more dialysis-free time, possible reduced complications from ESKD, fewer cannulisations may increase longevity of vascular access, and less accessing CVCs may reduce bacteraemia rates, as detailed under 5.1

**Comprehensive health-economic analysis indicated cost savings range of £26,125 - £19,875 = £6,250 median saving per patient year.*[17]

Estimation of carbon savings

1,964 patients on HD in hospital according to the Scottish Renal Registry report of 2025 with an estimated carbon footprint of 3.7 tCO2e per patient per year[17 18 19 20], or 7,267 tCO2e per year for the entire patient cohort.

Assuming 20% of the 1,964 patients (393) are suitable for incremental dialysis, there would be 20,456 fewer sessions per year.

Area	Carbon Calculations
Clinical waste	Clinical waste produced per treatment: 2.2kg* Carbon cost of treatment of clinical waste: 0.273 kgCO2e per kg of waste** Each treatment produces 2.2 x 0.273 = 0.6 kgO2e Over the course of a year, having one fewer treatment per week can prevent 52 x 0.6 = 31.2 kgCO2e per patient per year. Assuming 20% of Scotland's 1,964*** patients (393) are suitable for iHD, this action could prevent as much as 393 x 31.2 = 12.261 tonnes of CO2 emissions. *Weight provided by NHS Highland ** based on figures submitted to the Public Bodies Climate Change Report 2023/24 *** 2025 Scottish Renal Registry report (due for publication September 2025)
Travel	National median distance for outpatient appointment return journey according to PHS Discovery: 14 miles Green Healthcare Scotland Health Mile* carbon emission: 0.231 kgCO2e per mile

Area	Carbon Calculations
	Based on those numbers, each treatment produces 14 x 0.231 = 3.246 kgO2e Each prescription of incremental dialysis can prevent one appointment per week, resulting in (52 x 3.246 kgCO2e) 168.79 kgCO2e per year. Assuming 20% of Scotland's 1,964*** patients (393) are suitable for iHD, this action could prevent as much as 393 x 168.79 = 66.33 tonnes of CO2 emissions. *Carbon emission per mile per mode of transport, weighted by use, according census data *** 2025 Scottish Renal Registry report (due for publication September 2025)
Energy consumption	Average energy consumption per treatment: 5.4 kWh.* Carbon cost per kWh: 0.177 kgCO2e.** Each treatment produces 5.4 x 0.177 = 0.956 kgCO2e. Each prescription of incremental dialysis can prevent one appointment per week, e.g. 52 x 0.956 = 49.71 kgCO2e. Assuming 20% of Scotland's 1,964*** patients (393) are suitable for iHD, this action could prevent as much as 393 x 49.71 = 19.53 tonnes of CO2 emissions. *average of figures from manufacturer's manuals, not weighted according to number of machines across NHS Scotland ** UK Government Conversion factors 2025: condensed set *** 2025 Scottish Renal Registry report (due for publication September 2025)
Total saving	**98.12 tonnes CO2 emissions per year**

6. Risks and Issues

6.1 Fewer weekly dialysis hours requires monitoring of RKF to ensure safety and adequacy. To obtain an equivalent renal urea clearance rate of 11 mL/min, the adequate dialysis Kt / V should be 1.6 per session for 2 sessions per week or 1.2 per session for 3/week.[21]

Patient considerations are important to minimise risk; particularly fluid overload and electrolyte imbalance in patients given the intradialytic period. Patients with ongoing fluid overload or hyperkalaemia should be started on a thrice weekly regimen until these factors can be optimised with diuretics and dietetics. Consideration must also be given to the patient's ability cope with an eventual increase in HD time and/or frequency as RKF declines. Incremental HD requires regular monitoring of the patient's RKF.

Description of risk or issue	Mitigation / Action Plan
• Under dialysing – potassium, middle molecules • Fluid overload / pulmonary oedema • Reluctance to increase to 3 times weekly when clinically indicated	• Patient selection and optimisation • Calculating combined urine and dialysis urea clearances • Monthly monitoring of urine volume and bloods • Monitor trends in weight and fluid status • Optimise diuretics • Use of patient information leaflet or upfront discussion to highlight ultimate need to increase to the 'standard' 3 times weekly

7. Implementation Guidance

7.1 The opportunity for change highlights the importance of implementing this action. This modification will help your site and NHS Scotland achieve net-zero emissions by 2040 as stated in NHS Scotland's Climate Emergency & Sustainability Strategy 2022-2026.

7.2 Below is guidance on how you can implement this change within your area. If you require any further information or guidance, please contact the National Green Renal Programme team on:

Local Sustainability or Green Theatre Group:	
1.	Review opportunity for change and validate what this means locally.
2.	Provide National Green Renal Programme Team with validated information/local targets.
3.	Convene a discussion with the staff who need to implement it and those who are impacted by the action.
4.	Understand what the opportunity is for implementing the action locally: work already undertaken and challenges.
5.	Agree a local implementation plan.
6.	Implement local plan.
7.	Provide data as per measurement plan.
8.	Monitor implementation of action.

Measurement plan

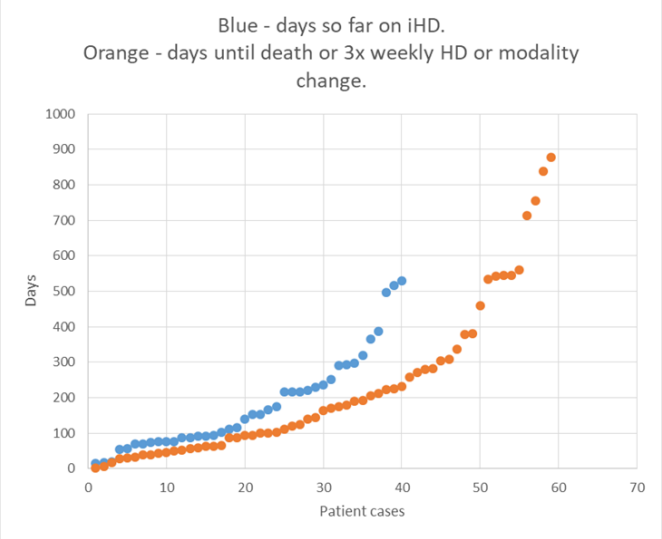
Name of Measure (carbon, cost, staff experience and patient outcome)	Type of measure (Outcome, Process, Balancing)	Concept being measured?	Where is the data available from?	Who is collecting the data?	Frequency of collection
Carbon	Calculated based on numbers of prevalent patients	Uptake, with cost factor applied	Annual registry report	Scottish Renal Registry	Annually
Cost	Calculated based on numbers of prevalent patients	Uptake, with carbon emission factor applied	Annual registry report	Scottish Renal Registry	Annually
Patient experience	Patient reported experience +/- Local surveys*	Satisfaction QoL	UKKA +/- local units	UKKA +/- local units	Annually As indicated locally

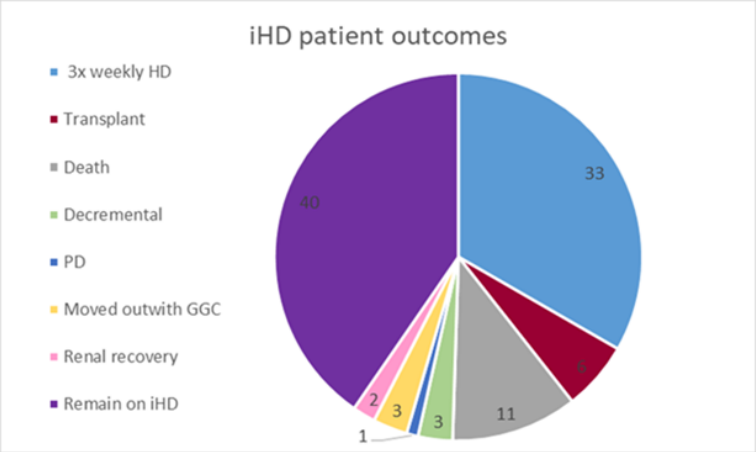
**Example survey available by contacting Green Renal Team - cfsdghs@nhs.scot*

Appendix 1 – NHS Greater Glasgow and Clyde, estimated impact of incremental haemodialysis on service delivery

The following is data shared by NHS Greater Glasgow and Clyde (NHS GG&C) on implementing incremental haemodialysis (iHD), up to Feb 2025. Up to 30% of prevalent haemodialysis (HD) patients may be cared for on an iHD protocol, therefore a greater than 10% reduction in waste and consumable costs.

- 99 patients on iHD (decremental not included in data); median age 66;
- median estimated glomerular filtration rate (eGFR) starting iHD: 7ml/min;
- median days on iHD to date (for those still on iHD): 146 days;
- median days on iHD for those 'complete' iHD and now on 3x weekly (or died or switched modality): 163 days (average 226, as data skew), range 2-878 days.





Carbon saving assumptions – see boundaries Section 4; additionally:

- Travel and estates data from Glasgow Royal Infirmary;
- Patients 6km round trip average in 50% car, 50% ambulance;
- Staff 11km (70% car, 25% EV, 5% bike) (bigger distances will increase carbon and cost savings).

	Incremental 1 year	3x weekly 1 year	Saving per patient year on iHD
Estimate environmental impact, tCO2e	2.611	3.791	1.18 [17,19,20,21]
Estimate cost, £	19,875	26,125	6,250 [16]

- Cumulative patient years on iHD in NHS GG&C = 56
- Cost savings= 56 x (x £6250 saving per patient year) = **£350,000;**
- Carbon saving = 56 x 1.18tCO2e per patient year= **66 tCO2e** saved over 3 years, with rates of uptake initially slow but then rising over the period reported.

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Version Control

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