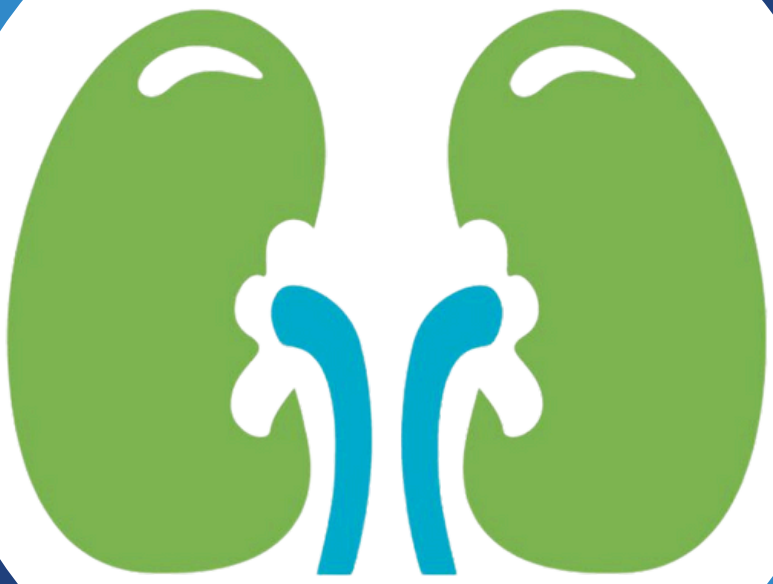
How-to Guide

Implementing Incremental Haemodialysis



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How-to Guide: Implementing Incremental Haemodialysis

Project: Sustainable Kidney Care – Implementing Best Practice

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This How-to guide is based on the available published evidence and on the experience and protocols of NHS Highland, NHS Greater Glasgow and Clyde, and the Lister hospital, sites where personalised haemodialysis prescribing has been established for some years.

Although this guide has been developed by experts in sustainability and sustainable kidney care, local teams should use their discretion in its implementation according to local context and requirements

Introduction

'Dialysis-free time' is a top priority for patients, yet in the era of shared decision making, we still prescribe rigid thrice weekly haemodialysis (HD) irrespective of residual kidney function (RKF).[1,2] Incremental HD (iHD) offers a personalised approach, increasing hours and sessions as clinically indicated, with observational and RCT data supporting safety, and is discussed in KDOQI Clinical Practice Guidelines.[3] Further background and evidence is available in **Appendix 1**. This resource is not a formal guideline but is intended to support units in developing their own protocols, based on local considerations and most up to date evidence.

Benefits	Risks
Quality of life – dialysis-free time Potential preservation of RKF*20 Environmentally more sustainable4 Financially more sustainable May improve cardiovascular outcomes Potentially fewer vascular access complications Shared decision making, empowered patients	Requires monthly urine collection Requires staff time to calculate / monitor RKF and adequacy Potential for harm or admission due to hyperkalaemia or fluid overload Requires additional emphasis on hypotension avoidance Reluctance to increase to 3 times weekly when RKF* declines

* RKF permits more stable fluid and electrolyte balance and greater removal of middle molecules.

Implementing iHD

1. Plan the change

Develop and agree a unit protocol based on Sections 2.2 - 2.7, below. Case studies and further papers are available to complement this.[4,5,6,7,8]

2. Communicate with stakeholders

- 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 the session before scheduled 'monthly bloods', 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.
- Confirm if IT can integrate formulae to automatically generate weekly combined StdKt/V i.e. dialysis adequacy report, ideally with safety checks included (see Appendix 2 for an example); if not, provide staff with calculator to input numbers themselves (for information on iHD adequacy please see Appendix 2).
- 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 iHDpatients' to facilitate monitoring.
- Have patient information leaflet or video of the principles of iHD ready for discussion with potential patients (For example PIL please see Appendix 3).

- Involve transport schedulers early if intention is 3 patients dialysing in 2 slots as shared transport will be impacted, see Section 2.7.
- Engage the team: present clinical and sustainability evidence; align with patient goals; invite feedback and discussion (see Appendix 4 Driver diagram).

3. Identify Suitable Patients

- Residual kidney function: KrU ≥ 2 ml/min/1.73 m^2 or eGFR ≥ 5 ml/min/1.73 m^2
- 24-hour urine volume > 600 mL (trials allow down to 500 mL/day)
- Stable nutritional and fluid status, Hb > 80 g/L, infrequent hospitalizations
- Able to engage with urine collections and accepting of future increases in dialysis frequency.

🚦 Quick Decision Guide	✅ Yes	❌ No
RKF: KrU* ≥ 2 ml/min/1.73m^2 or eGFR >5ml/min and UO ≥ 600 mL/day	Proceed to next question	Conventional HD likely needed
Clinically stable, no significant fluid overload, K+ generally <5.5mMol/L	Discuss option of iHDwith patient	Optimise patient and reassess
Monthly follow-up in place: labs, RKF, StdKt/V, weight, fluid overload, symptoms	Safe to start iHD protocol	Delay iHD initiation until protocol in place

* KrU – residual renal urea clearance

4. Monthly monitoring of residual kidney function with

- 24 hour urine volume for KrU
- Weekly combined StdKt/V (from RKF and dialysis delivery; should be > 2.0
- Review calcium, potassium, phosphate, urea - consider adjusting any medications prescribed 'post-dialysis', such as Alfacalcidol, as additional dose(s) may be required on non-dialysis days; consider a potassium-binder on 'long-gap' non-dialysis days if borderline potassium but all other criteria for iHD are met (off license use).
- Review BP, symptoms, and fluid balance and weight trends – consider escalating loop diuretics (e.g. furosemide) or combination with thiazide to promote potassium excretion, maximise urine output, and reduce fluid gains.
- Where possible, use IT systems to track dialysis adequacy metrics over time.

5. Consider increasing dialysis frequency if

- Hyperkalaemia (pre-HD potassium > 5.7 mmol/L on 2 mmol/L potassium dialysate)
- Excessive fluid gains (UF rate consistently > 10 mL/kg/hour)
- Excessive fluid shifts leading to recurrent episodes of hypovalaemia.
- Monthly KrU < 2 ml/min or urine volume < 600 mL on two occasions
- StdKt/V < 2.0 despite optimized 5-hour HD session with maximum blood flow rate and dialysis membrane size.
- Failure to thrive on twice weekly HD or patient preference.

Monitoring for patients on 1-2x/week dialysis:

Timepoint	Monitoring & Assessment	Adjustment Criteria
Week 0	Baseline RKF, labs, BP, weight, symptoms	If all criteria met, proceed
Monthly	Check KrU, UO, Total weekly StdKt/V, electrolytes, volume status	If stable, continue; if fail to meet criteria, increase hours or sessions (see above)

6. How to improve weekly StdKt/V

Where patients retain KrU >2 ml/min / pass more than 600ml of urine in 24 hours, yet have a weekly StdKt/V <2, staff should aim to improve dialysis adequacy for the patient, though taking personalised circumstances into consideration and ideally with a shared decision-making approach.

Examine dialysis access for issues including recirculation, increase dialyser membrane size, increase blood flow rate, increase dialysis time up to 5 hours. 2mmol K+ dialysate should be considered in patients with pre HD K+> 5mmol/L.

7. Other practical considerations

- Consider implementing iHD missing the 'middle' session initially.
- Later scheduling can consider 3 patients into 2 HD slots (Mon/Thurs, Tues/Fri, Wed/Sat) to improve efficiency or service capacity.
- Patient reviews (dietician, consultant etc.) can be more challenging to schedule.
- Avoid hypotension and hypovolemia to preserve RKF. Flexible target weights advised; manage hypertension pharmacologically before reducing weight.
- Any iHD patient who develops an intercurrent illness or hospital admission that requires a period of more frequent HD must have their residual kidney function / urine output reassessed before switching back to a twice weekly iHD schedule.

N.B. Decremental HD

Frail, co-morbid, or elderly patients may have little oral intake, slow metabolism and less requirement for HD. Such patients can be considered for 'decremental' dialysis if they are not a transplant candidate, and where QoL takes priority, potentially above survival benefit. In such patients, the same principles of personalised care and shared decision-making apply, but urine output and dialysis adequacy criteria may not be relevant, so long as it remains safe for the patient and aligned with their wishes.

Reporting

The main goal of this is to provide the tools to be able to safely implement personalised haemodialysis. Optional metrics you may wish to monitor to assess success of implementation would include:

- Proportion of incidental patients assessed as suitable for incremental HD
- Proportion of incidental patients commenced on twice weekly HD
- Proportion of prevalent patients maintained on twice weekly HD
- Proportion with completed, combined urine and dialysis monthly adequacy measures
- Feedback surveys for staff and patients

Conclusion

Incremental HD is a safe, eco-friendly, and patient-empowering option. With appropriate patient selection and structured follow-up, it aligns clinical excellence with environmental stewardship.

Appendix 1. Background and evidence

Haemodialysis (HD) is traditionally initiated with a fixed 3 times weekly regimen, based on studies in the 1980s of established HD patients with little residual kidney function (RKF).[2] 'Dialysis-free time' is a top priority for patients,[1] yet this rigid approach to prescribing can lead to overtreatment, accelerated loss of RKF, and unnecessary environmental and financial impact.[9]

Incremental haemodialysis (iHD) offers a personalised, flexible, and sustainable alternative: starting with a reduced dialysis dose and increasing as clinically indicated. The approach is suitable for patients with progressive CKD, a failing transplant, requiring a switch from PD, or AKI requiring renal support. 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 minimum threshold for adequate dialysis spKt / V should be 1.6 per session for 2 sessions per week or 1.2 per session for 3/week.[10]

iHD is evidenced by observational studies and RCTs, summarised elsewhere.[11,12,13,14,15] The 2015 KDOQI Clinical Practice Guideline for Haemodialysis Adequacy advise that the dose/frequency of dialysis may be reduced in patients with significant residual kidney function.[3] This is also reflected within the Renal Association Haemodialysis Guidelines which state, "twice weekly HD without an increase in treatment time may be acceptable if patients have a significant level of residual renal function, such as either a combined urinary urea and creatinine clearance (using the mean of the two measurements) or eGFR above 5ml/min/1.73m2, provided that residual renal function is monitored at least every 3 months and the frequency of dialysis is increased when renal function decreases." [16,17] Further guidance that may be useful when setting up a local protocol is available in this recent review article.[8]

Appendix 1. Background and evidence

Although recent clinical practice guidelines, including those from KDOQI and the Renal Association, have acknowledged the value of residual kidney function (RKF) and endorsed incremental hemodialysis as a viable option in select patients, their recommendations remain largely conceptual and lack detailed operational guidance. There is currently no comprehensive clinical practice guideline that standardizes the stepwise implementation of incremental HD across diverse patient populations or care settings

Importance of preserving residual renal function

Strategies that potentially preserve RKF may confer QoL and survival benefit through more stable fluid and electrolyte balance and a greater removal of middle molecules.[2,18,19] Evidence is mixed, but iHD is certainly non-inferior.[20] Factors that influence the rate of loss of RKF include primary renal diagnosis, comorbid disease, vascular access-related infection, the use of nephrotoxins, and certain characteristics of a patient's HD prescription including water quality and membrane type.[2] Intradialytic hypotension is also a major contributor to loss of RKF and is also associated with myocardial and cerebral stunning .[2,21] Preservation of RKF in iHD may mostly relate to fewer episodes of intradialytic hypotension; further minimised through a focus on immediate correction of hypotension and hypovolaemia on HD. [2,11]

Benefits of Incremental Dialysis

The main benefits of iHD are fewer dialysis treatments and better quality of life of new HD patients.[1]There is no additional mortality risk, and hospital admissions may be fewer (relative risk = 0.31; 95% CI 0.18–0.54).9,12 Data from observational studies (but not RCTs) suggest maintaining urine output and preserving RKF may reduce complications of ESKD, including intradialytic hypotension, and anaemia; iron and erythropoetin stimulating agent requirements may be lower.[9] Fewer cannulations of the patients' AVF/graft may increase longevity of vascular access, and reduced accessing of CVCs may reduce bacteraemia rates, particularly in the highest risk period of the first 3 months.[22] In addition to the patient-related benefits listed above, financial costs, service demand, and greenhouse gas emissions are reduced,[15,23] the latter due to reduced travel, energy use, use of dialysis consumables and pharmaceuticals, and waste generated by a typical HD treatment.

Risks associated with Incremental Dialysis

Patient considerations are important to minimise risk; particularly fluid overload and electrolyte imbalance in patients given the increased interdialytic period. Patients with ongoing fluid overload or hyperkalaemia should be started on a thrice weekly regimen until these factors can be optimised with changes to the HD prescription, diuretics and dietetic input. 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.

Appendix 2. Calculating dialysis adequacy

Required info for calculating combined (urine and dialysis) weekly StdKt/V [24,25]

- Age
- Height
- 24hr urine volume
- Urinary urea concentration (mmol/ml)
- Pre-HD urea
- Post-HD urea
- Duration of dialysis
- Number of dialysis sessions / week
- Ultrafiltration volume
- Post-HD weight

Male, twice weekly:

V= (2.447+(0.3662*Post-HD weight)+(0.1074*Height)-(0.09516*Age))*1000

KrU urea clearance ml/min = 2*(Urinary urea*Urine Volume)/(1440*(Post-HD urea+Pre-HD urea))

Weekly Kt/V Urine = (KrU urea*9500)/V

Weekly StdKt/V dialysis: one formula for this is taken from the KDOQI 2006 Hemodialysis Adequacy Guidelines:[26]

$$stdKt/V = \frac{\frac{10080 \cdot (1 - e^{-eKt/V})}{t}}{\frac{1 - e^{-eKtV}}{spKt/V} + \frac{10080}{N \cdot t} - 1}$$

where
spKt/V is the single-pool Kt/V
and eKt/V is the equilibrated Kt/V, computed from the single-pool Kt/V (spKt/V)
and (t) is session length (t)
and N = number of times per week
please note that the methods of calculating spKt/V and eKt/V will vary according to the method of post-dialysis sampling used.

Combined, weekly StdKt/V = Kt/V Urine+ StdKt/V dialysis

Female, twice weekly:

V= (2.097+(0.2466*Post-HD weight)+(0.1074*Height)-(0.1069*Age))*1000
Remainder of the formula as above for Males

Once weekly adequacy can also be calculated from automated systems or calculators.[27] Other online calculator tools are available that might suit your unit's data systems, e.g. Solute Solver and SPEEDY[24].

Example of an automated report*:

Weekly stKt/V calculation for [redacted] CHI [redacted]

Dialysis Shift [redacted]

Calculation based on HD sessions 2 days per week

No. of HD sessions per week (according to HD Prescription screen) 2

Please note information correct as of: 14/11/2025

*Essential parameters flagged with asterisk

HD data and Clearance

*Date HD Session	07/11/2025		
*UF (Litres)	3	30 min Urea	11.40
*HD Duration (Hrs)	4	30minR	0.35
*Post HD weight	80.0	spKt/V	1.33
*PreD Urea	32.0	eKt/V	1.24
*PostD Urea	11.0	URR	67
*HD Prescription Screen No. days	2	Weekly HD stKt/V	1.29

Urinary Clearance

*Date urine	10/11/2025		
*Time	1440		
*Volume (ml)	1019	V	34.0
*Urine Urea (mmol/L)	80.5	Urea clearance ml/min	2.60
*Height (m)	155.00	Urea clearance L/wk	26.22
*Age (required if male)	69.45	Weekly Urine KtV	0.77

Urinary clearance data based on results in 'Urine Electrolytes' screen and height recorded in 'BP, Weight etc' screen

Total weekly stKt/V

Total weekly Std Kt/V	2.06

Patient likley to require 3 x per week HD if any of the following:

1. pre-HD potassium > 5.7 mmol/L 2. Urine output < 600 ml/day 3. urea clearance < 30 L/wk

4. Low BP on HD 5. UF > 3000 ml per 4-hour session or > 3750ml per 5-hour session in a 75kg person

Date printed: 14/11/2025

The SQL code used to generate this report is available on request by emailing The Centre for Sustainable Delivery's National Green Renal Programme at cfsdghs@nhs.scot.

* n.b. different nomenclature in this report (Weekly stKt/V = weekly StdKt/V; weekly HD stKt/V = weekly StdKt/V dialysis)

Appendix 3. Template PIL

Renal Services Information about Incremental Haemodialysis (iHD)

What is Incremental Dialysis?

When starting dialysis, some patients will still have remaining (residual) kidney function - they still make urine.

Incremental dialysis takes into account your remaining kidney function and allows the renal team to tailor your dialysis treatment to what you need. This generally means that while your kidney function remains stable and you feel well, you will dialyse twice per week, usually for between 3 and 5 hours each session, depending on how much dialysis your body needs.

Who is suitable for incremental haemodialysis?

All patients will be considered if they have had a steady decline in kidney function and have been relatively free of symptoms of their chronic kidney disease up to the point of starting dialysis, including:

- Low clearance patients
- Failing transplant recipients
- Peritoneal dialysis patients moving to haemodialysis and patients with acute kidney injury may also be suitable.
- You must, however, still pass urine. We need a 24 hour urine collection from you every month to measure your remaining (residual) kidney function.

The main benefits of incremental haemodialysis are:

- To preserve residual kidney function
- Better quality of life
- Fewer fistula cannulations (needles)
- Lower risk of contracting an infection
- Less time at dialysis, to start with

The risks of incremental haemodialysis dialysis are:

- Fluid overload
- Electrolyte imbalance (high potassium)
- Needs regular assessment and monitoring of residual kidney function with urine collections

What happens if I need to increase the frequency of my dialysis days?

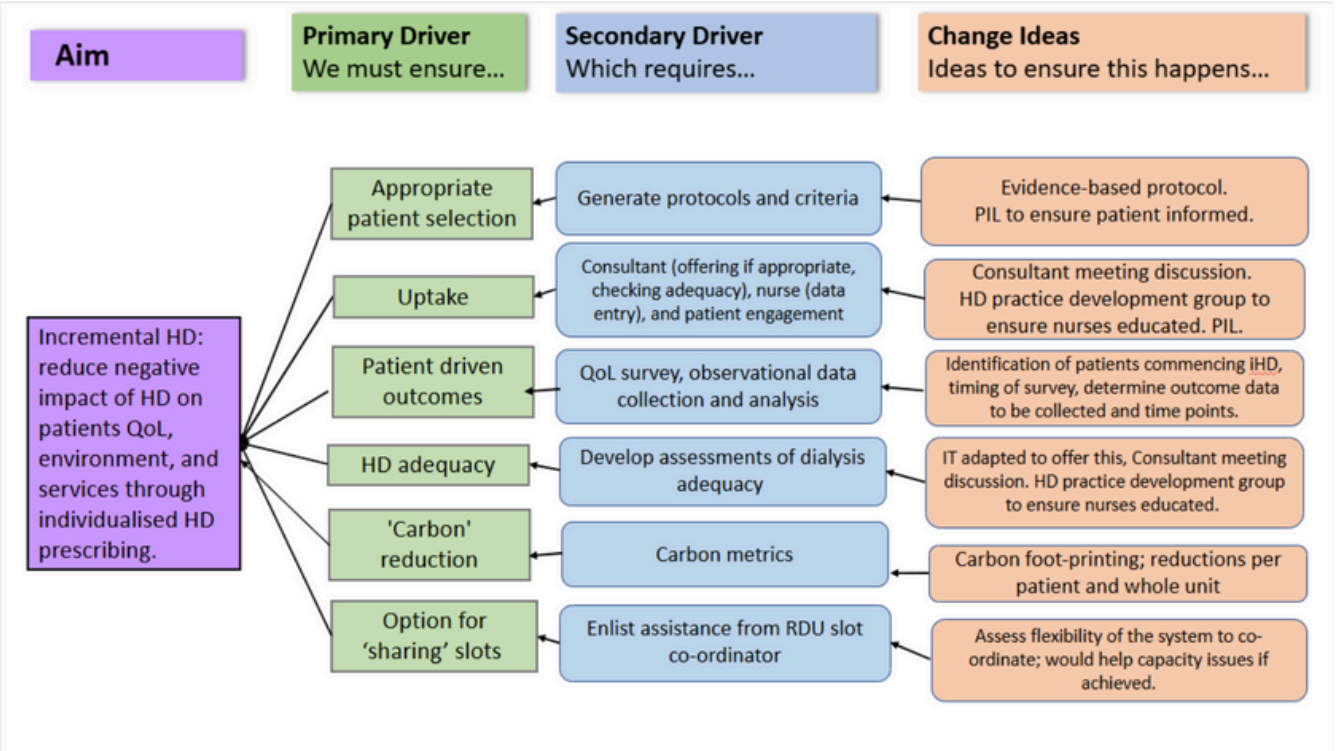
At some point you may need to increase your dialysis hours and/or the number of sessions you dialyse each week to the usual three days per week. This may be after a few weeks, months, or even years, when your remaining kidney function is lost, completely, and one or two dialysis sessions a week is no longer enough to keep you well.

Reasons to move to usual 3 times weekly treatment include:

- High potassium (greater than 5.7mmol)
- Breathlessness from high fluid gains
- Episodes of low blood pressure on dialysis
- Blood tests showing too little dialysis
- Urine output less than 600ml a day (from your 24-hour urine collections)
- Feeling unwell because of a build-up of kidney poisons (e.g. feeling sick, itchy, or going off your food)

Your dialysis nurse and consultant will look out for these and will discuss with you when you need to increase the number of dialysis sessions you need each week. If you have any concerns or questions, your renal team will be more than happy to help you.

Appendix 4 - Driver diagram



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