Implementing Incremental Haemodialysis: How to Guide

A Greener, Patient-Centred Approach to Starting Dialysis

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This guide has been developed to support implementation, but should not be considered a formal clinical practice guideline; local units should use their discretion in implementation accounting for local service delivery.

Contents

Contributors

Developed by Dr Eleanor Murray and Dr Marta Arias on behalf of NHS Scotland's National Centre for Sustainable Delivery and UK Kidney Association. 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. Particular mention of Dr Stewart Lambie, Stuart Ross, and Dr Jamie Traynor who developed the tools for local implementation.

1.0. About this guide

This resource has been produced to enable renal teams to implement incremental haemodialysis, adjusted to local considerations, to realise the following benefits:

✓ Preserves residual kidney function
✓ Reduces treatment burden and improves quality of life
✓ Delivers significant environmental and financial savings

1.1. 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. As yet, detailed formal clinical practice guidelines for the implementation of iHD remains lacking, although it is discussed at high level in the Kidney Disease Outcomes Quality Initiative (KDOQI) Clinical Practice Guidelines[3], with observational and randomised control trial (RCT) data indicating it is safe. Further background and evidence are available in Appendix 1. This resource is not a formal guideline, but 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*[23] Environmentally more sustainable[4] 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

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

2.0. Implementing iHD:

2.1. Plan the change

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

2.2. 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 '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.
- Explore if IT can integrate formulae to automatically generate weekly combined StKt/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 calculating 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 iHD patients' to improve ease of monitoring.
- Have patient information leaflet (PIL) or video of the principals of iHD ready for discussion with potential patients (For example PIL please see Appendix 3).
- 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 (see Appendix 4 Driver diagram).

2.3. Identify Suitable Patients

- Residual kidney function: KrU ≥ 2 ml/min/1.73 m² or eGFR ≥ 5 ml/min/1.73 m²
- 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/1.73m² **or eGFR >5**ml/min **and UO ≥ 600** mL/day	Proceed to next question	Conventional HD likely needed
Clinically stable, no significant **fluid overload, K+** generally **<5.5**mMol/L	Discuss option of iHD with patient	Optimise patient and reassess for iHD
Monthly follow-up in place: labs, RKF, Kt/V, weight, fluid overload, symptoms	Safe to start iHD protocol	Delay iHD initiation until protocol in place

* KrU – residual renal urea clearance

2.4. Monthly monitoring of residual kidney function with:

- 24 hour urine volume, KRU
- spKt/V and/or weekly combined StKt/V (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; can consider a potassium-binder on 'long-gap' non-dialysis days if borderline potassium despite optimising dialysis but all other criteria for iHD are met (off license use).
- Review blood pressure, symptoms, and fluid balance and weight trends – consider escalating loop diuretics (e.g. furosemide, including high dose e.g. 250mg) 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

2.5. Consider increasing dialysis frequency if:

- Hyperkalaemia (pre-HD potassium > 5.7 mmol/L on 2 mmol/L 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
- StKt/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:

Timepoint	Dialysis Frequency	Monitoring & Assessment	Adjustment Criteria
Week 0	1–2x/week	Baseline RKF, labs, BP, weight, symptoms	If all criteria met, proceed
Monthly	Maintain current freq.	Check KRU, UO, Total weekly Kt/V, electrolytes, volume status	If stable, continue; if fail to meet criteria, increase hours or sessions (see above)

2.6. How to improve weekly Kt/V

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

2.7. Other practical considerations

- Consider implementing iHD missing the 'middle' session initially.
- 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, usually aiming for neutral balance i.e. removing washback only; 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 'decremental' if they are not a transplant candidate, and where quality of life takes priority, potentially above survival benefit. In such patients, the same principals 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.

3.0. 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

4.0. 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,[i] 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 progressive CKD, failing transplant, switch from peritoneal dialysis (PD), or Acute Kidney Injury (AKI) requiring Kidney Replacement Therapy (KRT). 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.[10]

iHD is evidenced by observational studies and RCTs, summarised elsewhere.[11,12,13,14,15]. As mentioned, although formal, detailed clinical practice guidelines aiding the implementation of iHD are lacking, 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 or eGFR above 5ml/min/1.73m^2, 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]

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.[218],[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 focus on immediate correction of any episodes of hypotension and hypovolaemia on HD. [2,17]

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).[15,19] Data from observational studies (but not RCTs) suggest maintaining urine output and preserving RKF may reduce complications of end stage kidney disease, including intradialytic hypotension, and anaemia; iron and erythropoetin stimulating agent requirement may be less.[15] Fewer cannulations of the patients' arteriovenous fistula graft may increase longevity of vascular access, and less accessing central venous catheter 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 carbon equivalents are

reduced.[15,23] The latter due to reduced travel, energy use, dialysis consumables, 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 interdialytic 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.

Appendix 2. Calculating dialysis adequacy

Required info for calculating StKt/V [24,26]:

- Age
- Height
- 24hr urine volume
- Urinary urea concentration mmol/ml
- Pre-HD urea
- Post-HD urea
- Duration of dialysis
- 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))
Kt/V Urine = (KrU urea*9500)/V
To calculate HD component of stKt/V, one method is the formula below. This was proposed by Leypoldt and modified by Depner and is cited in the KDOQI 2006 Hemodialysis Adequacy Guidelines. [25]

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

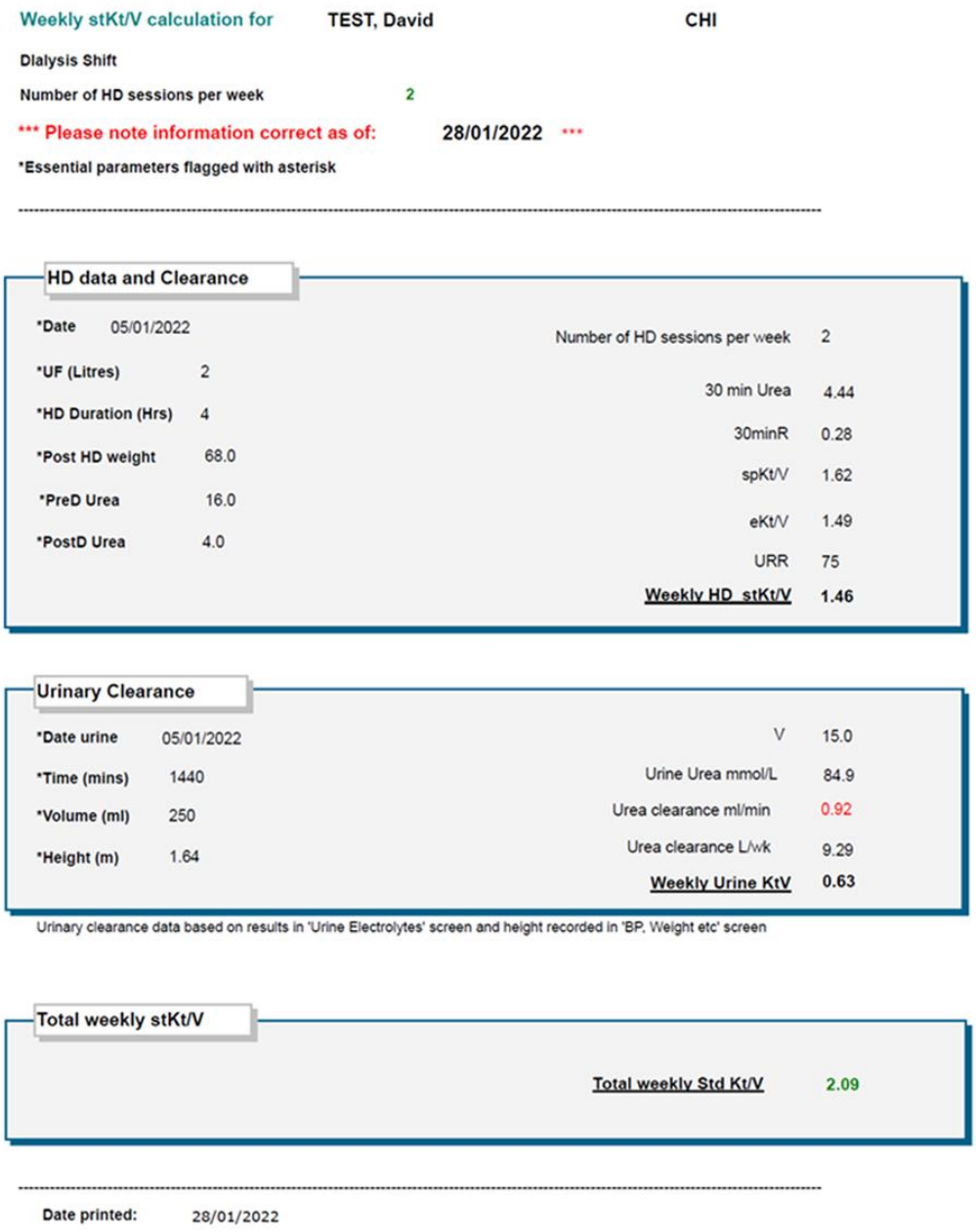
Where:
spKt/V is the single-pool Kt/V
and *eKt/V* is the equilibrated Kt/V, computed from the single-pool Kt/V (spKt/V)
and (t) is session length (t)
and N = number of times per week

Please note that the methods of calculating spKt/V and eKt/V will vary according to the method of post-dialysis sampling used.[26]

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.[26]

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 (ureakinetics.org) and SPEEDY.[24]

Example of an automated report:



Weekly stKt/V calculation for TEST, David CHI

Dialysis Shift

Number of HD sessions per week 2

*** Please note information correct as of: 28/01/2022 ***

*Essential parameters flagged with asterisk

HD data and Clearance

*Date	05/01/2022	Number of HD sessions per week	2
*UF (Litres)	2	30 min Urea	4.44
*HD Duration (Hrs)	4	30minR	0.28
*Post HD weight	68.0	spKt/V	1.62
*PreD Urea	16.0	eKt/V	1.49
*PostD Urea	4.0	URR	75
		Weekly HD stKt/V	1.46

Urinary Clearance

*Date urine	05/01/2022	V	15.0
*Time (mins)	1440	Urine Urea mmol/L	84.9
*Volume (ml)	250	Urea clearance ml/min	0.92
*Height (m)	1.64	Urea clearance L/wk	9.29
		Weekly Urine KtV	0.63

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 2.09

Date printed: 28/01/2022

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.

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 in to account your remaining kidney function and allows the renal team to individualise 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 stable decline in kidney function and have been relatively symptom free from their chronic kidney disease up to the point of starting dialysis, including:

- Low clearance patients
- Failing transplant recipients
- Acute Kidney Injury patients
- Peritoneal dialysis patients moving to haemodialysis
- You must however still pass urine. We need a 24 hour urine sample 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

What happens if I need to increase my dialysis days?

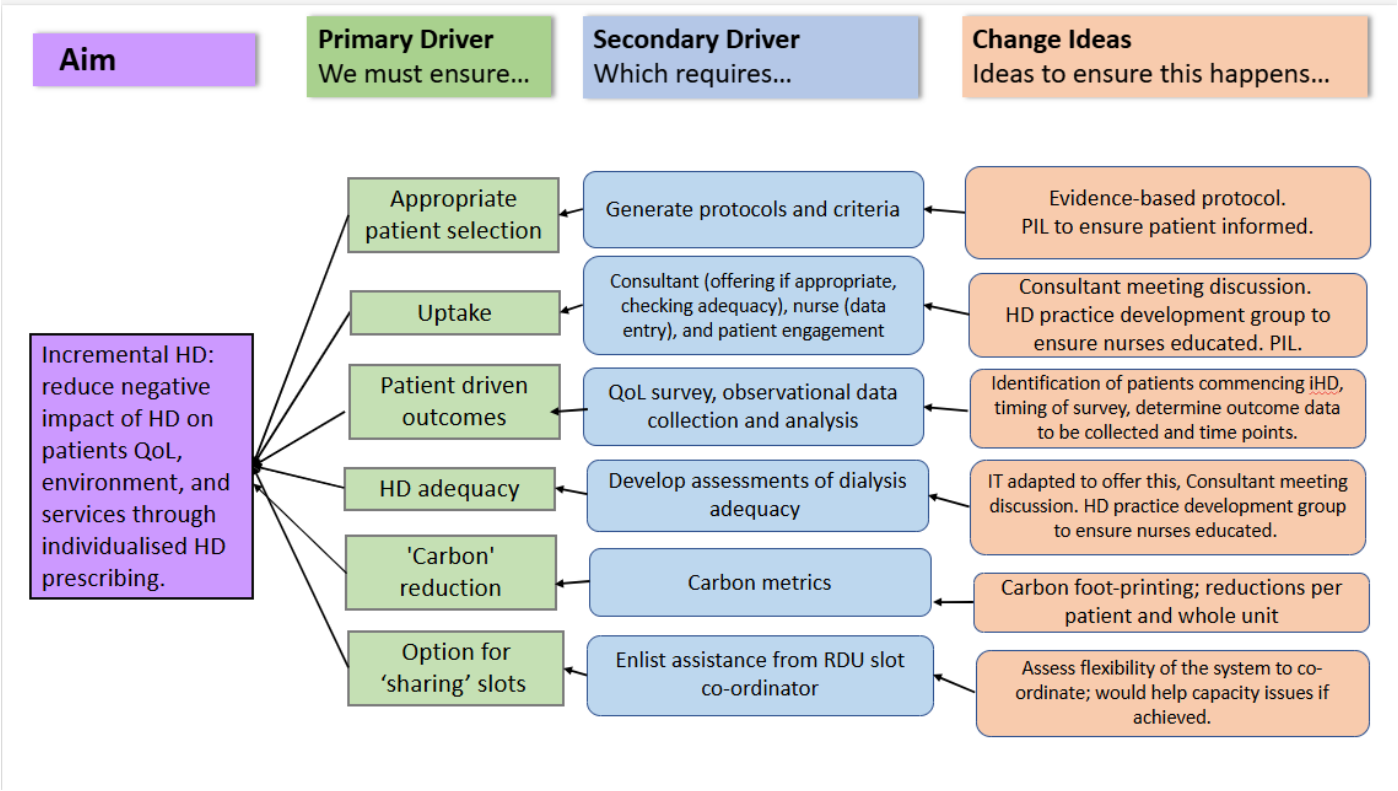
At some point you will need to increase your dialysis hours, and/or sessions to the usual three days per week. This may be after a few weeks, months, or even years, when your remaining kidney function is lost and two dialysis sessions a week is no longer enough to maintain a healthy body.
Reasons to move to standard 3 times per week include:

- High potassium (greater than5.7mmol)

- 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 24-hour urine collections)
- Feeling unwell i.e. increased nausea, itch

Your dialysis nurse and consultant will look out for these and will discuss it with you when you need to increase to 3 dialysis sessions. 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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