

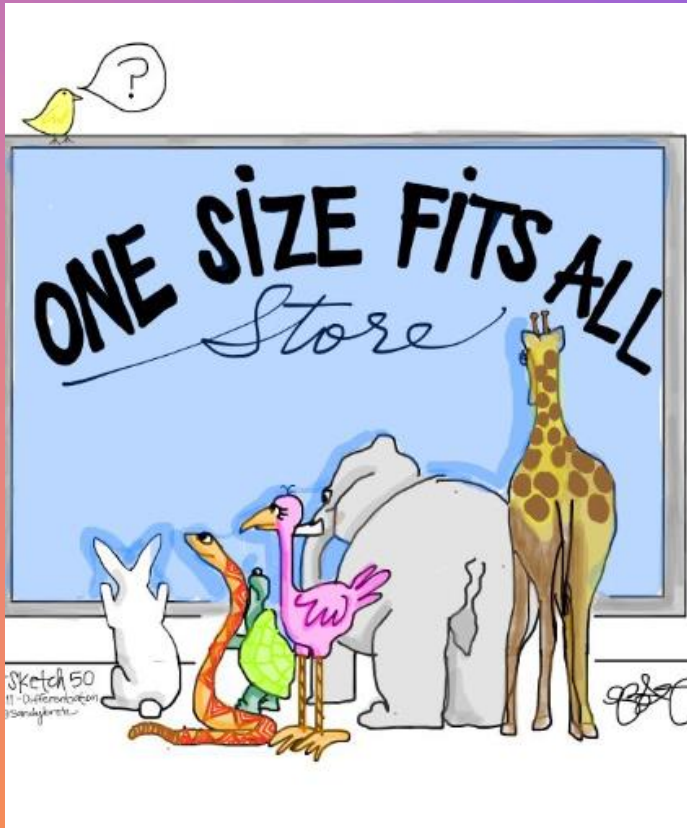
# Η ΕΠΙΔΡΑΣΗ ΤΗΣ ΣΤΑΔΙΑΚΗΣ ΑΙΜΟΚΑΘΑΡΣΗΣ (INCREMENTAL DIALYSIS) ΣΤΟΝ ΕΓΚΕΦΑΛΟ

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## ΣΤΟ ΤΕΛΟΣ ΤΗΣ ΟΜΙΛΙΑΣ ΘΑ ΓΝΩΡΙΖΕΤΕ:

- Πώς η *έναρξη* Αιμοκάθαρσης επηρεάζει τον Εγκέφαλο?
- Τί είναι η Σταδιακή (Incremental) Αιμοκάθαρση?
- Πώς επηρεάζει η Σταδιακή Αιμοκάθαρση τον εγκέφαλο?
- Συσχετίζεται η Σταδιακή Αιμοκάθαρση με την διατήρηση της Υπολειπόμενης Νεφρικής Λειτουργίας?
- Ποια είναι τα οφέλη της διατήρησης της Υπολειπόμενης Νεφρικής Λειτουργίας σε σχέση με τον Εγκέφαλο?

## ΠΩΣ ΕΠΗΡΕΑΖΕΙ ΤΟΝ ΕΓΚΕΦΑΛΟ Η Ή ΕΝΑΡΞΗ ΑΙΜΟΚΑΘΑΡΣΗΣ?

DIALYSIS "SHOCK"

### Decline in Cognitive Function after Dialysis Initiation <sup>13</sup>

Cognitive domain z score	Rate of change			Dialysis (vs. pre-dialysis)	P value	P value for joint effect <sup>a</sup>
	Pre-dialysis	Post-dialysis	P value			
Global	-0.01 (-0.08 to 0.05)	0.01 (-0.07 to 0.09)	0.60	-0.04 (-0.15 to 0.08)	0.56	0.81
Memory	0.23 (0.07-0.39)	0.11 (-0.08 to 0.30)	0.24	-0.08 (-0.36 to 0.20)	0.57	0.12
Executive function	-0.01 (-0.15 to 0.12)	-0.12 (-0.28 to 0.04)	0.15	-0.20 (-0.44 to 0.04)	0.10	0.01

**Setting:** CRIC study population

**Population:** 212 CKD patients; eGFR<20ml/min/1.73m<sup>2</sup>, or dialysis vintage < 2 years. 123 patients without dialysis at the end of the study, 32 patients initiated dialysis during follow-up, 52 patients were on dialysis at the baseline.

**Exposure:** dialysis initiation

**Outcomes:** cognitive function, and memory

**Results:** all domains declined, executive function significantly deteriorated after dialysis initiation.

Kidney Int 91: 948, 2017

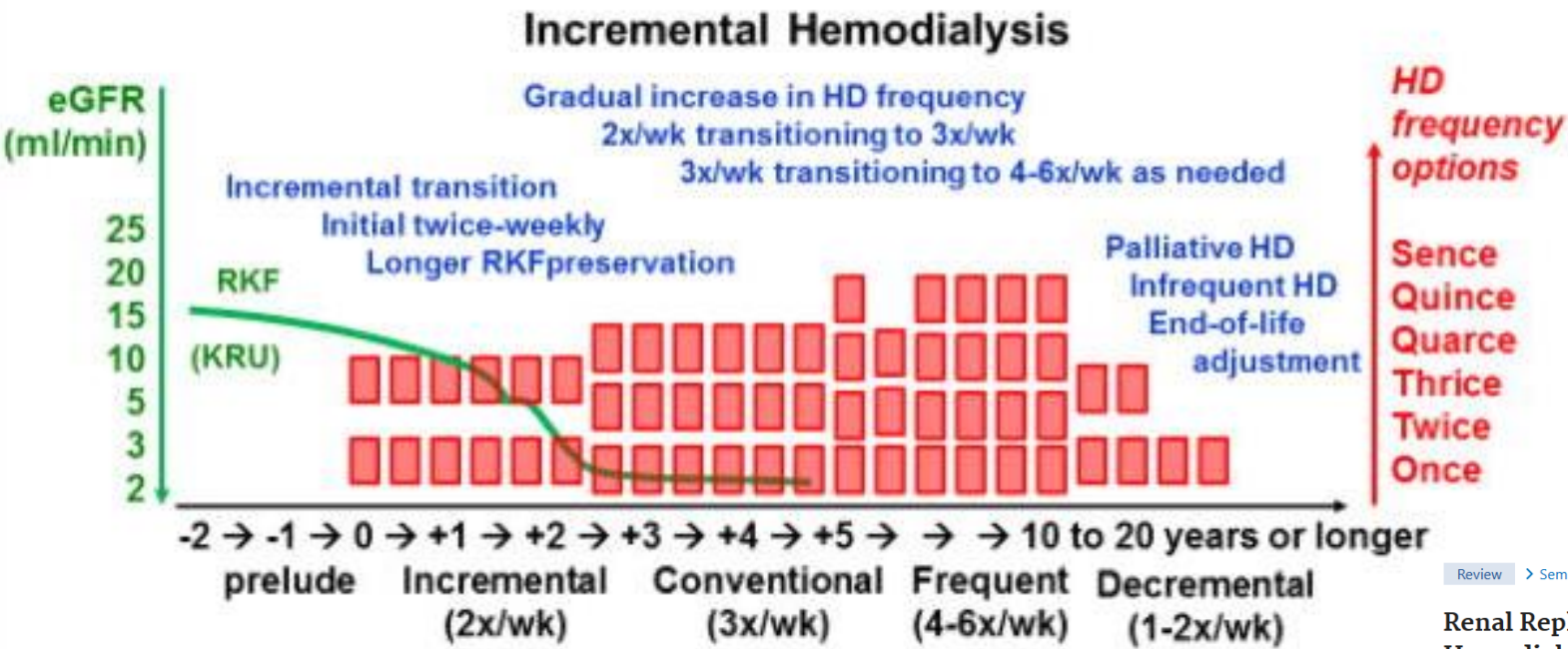
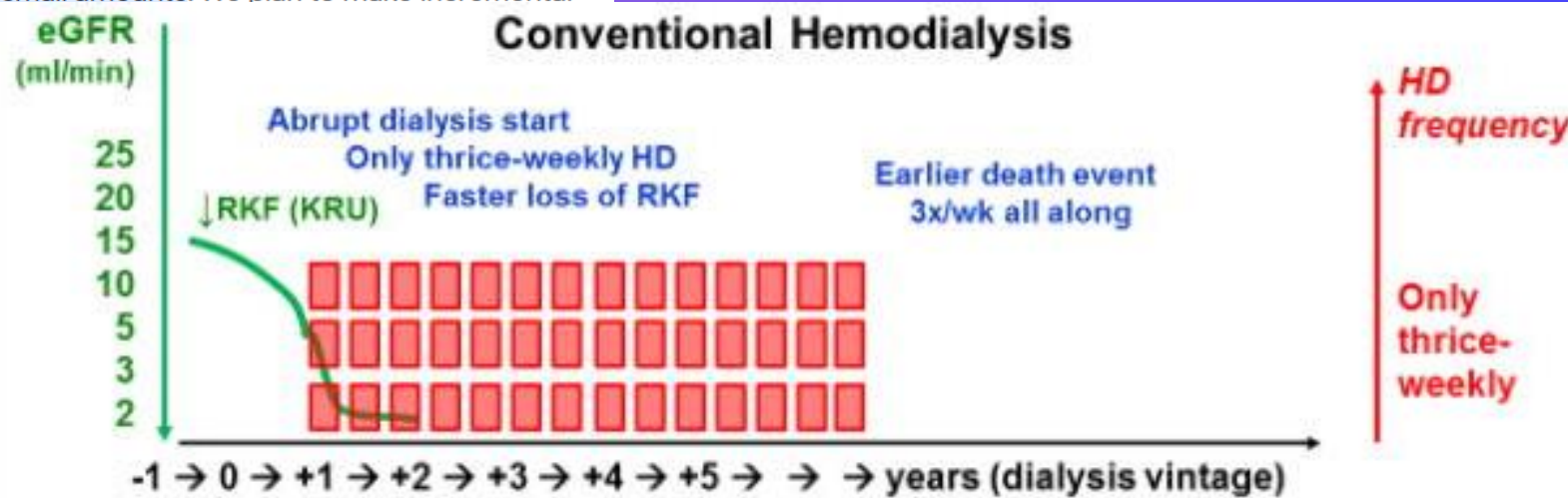
- Η έναρξη Αιμοκάθαρσης είναι μείζον ψυχοπιεστικό και στρεσογόνο γεγονός ζωής
- Όλοι οι τομείς γνωστικής λειτουργίας έδειξαν επιδείνωση με την έναρξη της αιμοκάθαρσης, ειδικά η εκτελεστική λειτουργία

What does it mean to be incremental?

happening gradually, in a series of small amounts: We plan to make incremental improvements to our existing pro

cambridge.org  
https://dictionary.cambridge.org > dicti

WHAT, WHY AND HOW



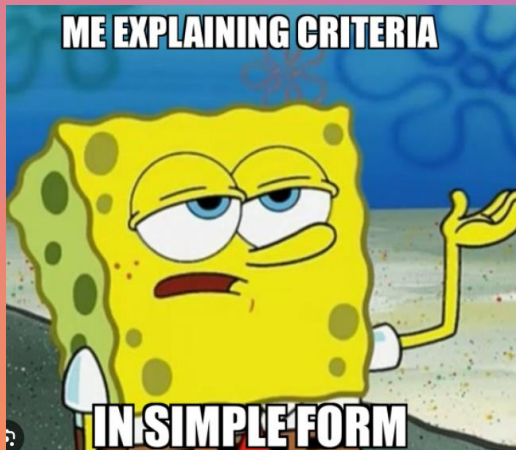
Review > Semin Dial. 2017 May;30(3):251-261. doi: 10.1111/sdi.12601. Epub 2017 Apr 18.

Renal Replacement Therapy and Incremental Hemodialysis for Veterans with Advanced Chronic Kidney Disease

TAL

πό το  
\$  
νεφρική

## ΣΤΑΔΙΑΚΗ ΑΙΜΟΚΑΘΑΡΣΗ, ΕΙΝΑΙ ΓΙΑ ΟΛΟΥΣ?



- Επαρκή υπολειπόμενη νεφρική λειτουργία  $>600$  ml/24h
- Μικρή αύξηση βάρους ανάμεσα στις αιμοκαθάρσεις  $<2.5$  kg (ή  $<5\%$  του βάρους)
- Περιορισμένη ή εύκολα διαχειρίσιμη καρδιαγγειακή και πνευμονική νοσηρότητα
- «Συμβατό» σωματικό μέγεθος για την υπολειπόμενη νεφρική λειτουργία
- Όχι επεισόδια υπερκαλιαιμίας
- Όχι εκσεσημασμένη Υπερφωσφαιμία (πχ  $>8$ g/dl)
- Καλό επίπεδο θρέψης και λειτουργικό status όχι υπερκαταβολικός
- Όχι συχνές νοσηλείες και λίγες συνυπάρχουσες νοσηρότητες
- Χωρίς εκσεσημασμένη Αναιμία (Hb $<8$ mg/dl) και καλή ανταπόκριση στους αυξητικούς παράγοντες
- KRU $>3$  ml/min

# The reasons for a clinical trial on incremental haemodialysis FREE

Francesco G Casino, Carlo Basile ✉, Dimitrios Kirmizis, Mehmet Kanbay, Frank van der Sande, Daniel Schneditz, Sandip Mitra, Andrew Davenport, Loreto Gesualdo on Behalf of the Eudial Working Group of ERA-EDTA [Author Notes](#)

*Nephrology Dialysis Transplantation*, Volume 35, Issue 11, November 2020, Pages 2015–2019, <https://doi.org/10.1093/ndt/gfaa220>

**Published:** 16 October 2020 **Article history** ▼

Questionnaire	Study arm	Time point			Between-arm comparison, $P^a$
		Baseline	6 mo	12 mo	
CFS	Standard	2.9 ± 1.3	3.1 ± 1.4	3.0 ± 1.4	0.18
	Incremental	2.9 ± 1.2	3.0 ± 1.0	2.7 ± 1.0	
Study protocol	Standard	32.2 ± 11.8	35.5 ± 12.4	33.8 ± 12.9	0.50
	Incremental	33.8 ± 16.2	33.0 ± 15.3	33.0 ± 15.3	

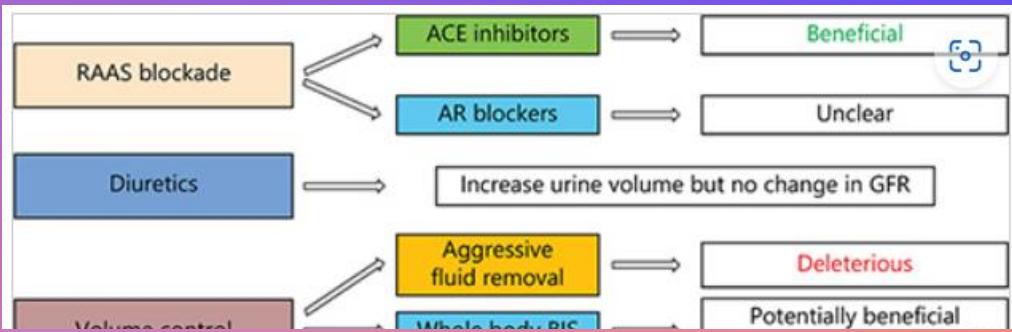
## IHDIP: a controlled randomized trial to assess the security and effectiveness of the incremental hemodialysis in incident patients

Javier Deira ✉, Miguel A. Suárez, Francisca López, Emilio García-Cabrera, Antonio Gascón, Eduardo Torregrosa, Giannina E. García, Jorge Huertas, Jose C. de la Flor, Suleya Puella, Jonathan Gómez-Raja, Jesús Grande, José L. Lerma, Carlos Corradino, Carlos Musso, Manuel Ramos, Jesús Martín, Carlo Basile & Francesco G. Casino

Incremental	2.0 (IQR, 1.0–4.5)	2.0 (IQR, 0.5–4.0)	2.0 (IQR, 0.5–4.0)
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## ΠΩΣ ΕΠΗΡΕΑΖΕΙ Η ΣΤΑΔΙΑΚΗ ΑΙΜΟΚΑΘΑΡΣΗ ΤΟΝ ΕΓΚΕΦΑΛΟ?

- Δεν υπάρχουν πολλές μελέτες που να εξετάζουν ΑΜΕΣΑ κάποια συσχέτιση
- Μέχρι τώρα, ο κύριος στόχος των μελετών είναι εάν είναι ασφαλής
- Η Σταδιακή αιμοκάθαρση είναι ασφαλής
- Πιθανότατα αμβλύνει τα συμπτώματα άγχους και κατάθλιψης που σχετίζονται με την έναρξη
- Δυο RCT's αναμένονται σύντομα, η **IHDIP** (Incremental Hemodialysis in Incident Patients) και η RandomizEd clinicAL trial on the efflcacy and saFety of incremental haEmodialysis' (**REAL LIFE**)



[Ther Clin Risk Manag.](#) 2021; 17: 1177–1186.

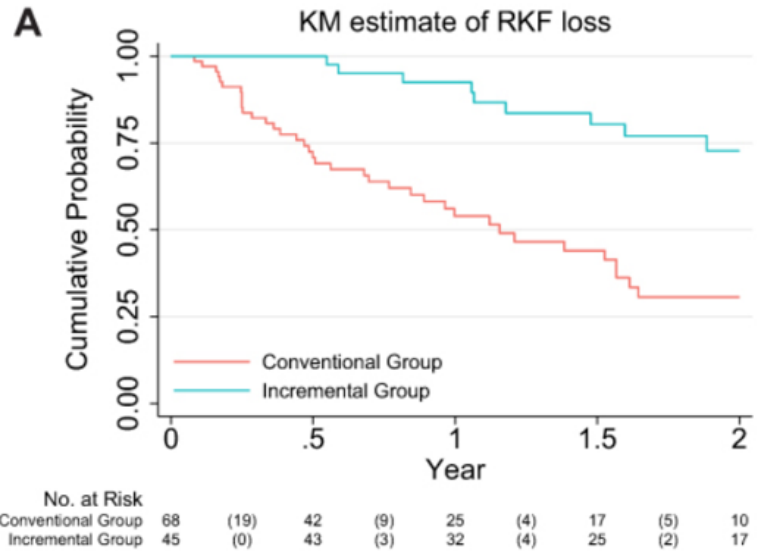
PMCID: PMC8598204

Published online 2021 Nov 13. doi: [10.2147/TCRM.S332218](https://doi.org/10.2147/TCRM.S332218)

PMID: [34803381](https://pubmed.ncbi.nlm.nih.gov/34803381/)

### Benefits of Incremental Hemodialysis Seen in a Historical Cohort Study

[Weisheng Chen](#), <sup>1</sup> [Mengjing Wang](#), <sup>1, 2</sup> [Minmin Zhang](#), <sup>1</sup> [Weichen Zhang](#), <sup>1</sup> [Jun Shi](#), <sup>1</sup> [Jiamin Weng](#), <sup>1</sup> [Bihong Huang](#), <sup>1</sup> [Kamyar Kalantar-Zadeh](#), <sup>3, 4, 5</sup> and [Jing Chen](#) <sup>1, 2</sup>



- Η συχνή Αιμοκάθαρση μειώνει την υπολειπόμενη νεφρική λειτουργία
- Η σταδιακή Αιμοκάθαρση συσχετίζεται με καλύτερη διατήρηση της Υπολειπόμενης Νεφρικής Λειτουργίας



# ΠΟΙΑ ΕΙΝΑΙ ΤΑ ΟΦΕΛΗ ΤΗΣ ΔΙΑΤΗΡΗΣΗΣ ΤΗΣ ΝΕΦΡΙΚΗΣ ΛΕΙΤΟΥΡΓΙΑΣ ΣΕ ΣΧΕΣΗ ΜΕ ΤΟΝ ΕΓΚΕΦΑΛΟ?

Elgendy et al. *BMC Nephrology* (2022) 23:263  
<https://doi.org/10.1186/s12882-022-02892-7>

BMC Nephrology

RESEARCH

Open Access



## Can residual kidney function affect quality of life and cognitive function in hemodialysis patients?

Asmaa Elgendy<sup>1</sup>, Adel I. Abdelsalam<sup>2</sup>, Mostafa Mansour<sup>3</sup> and Mohammed K. Nassar<sup>1\*</sup>

### Abstract

**Background:** Residual kidney function (RKF) may provide many benefits to patients on permanent renal replacement therapy that are reflected in better control of biochemical parameters. In hemodialysis patients, quality of life (QOL) and cognitive function are often impaired. This study aimed to assess the predictors of RKF and its impact on QOL and cognitive function in chronic hemodialysis patients.

**Patients and methods:** The study involved seventy-eight patients suffering from end-stage renal disease on regular

**Table 4** MoCA domains according to RKF status

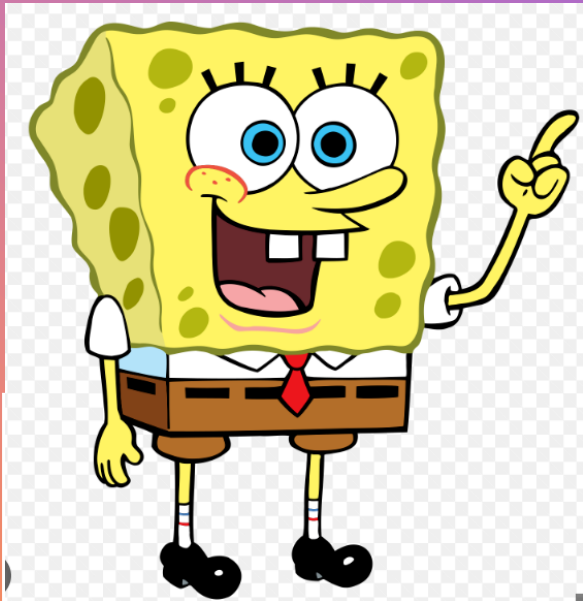
MoCA domains	Max points of test	Group A (RKF) (n = 29)	Group B (No RKF) (n = 49)	P
Level of education (< 12 years)		23 (79.3%)	29 (57.1%)	<b>0.047</b>
Visuospatial executive	5	4 (3–5)	3 (1–4)	<b>0.002</b>
Naming	3	3 (3–3)	3 (3–3)	0.346
Attention	6	5 (4.50–5)	4 (4–5)	<b>0.004</b>
Language	3	3 (2–3)	2 (2–3)	<b>0.037</b>
Abstraction	2	2 (1.50–2)	2 (1–2)	0.237
Delayed recall	5	4 (3–4)	3 (3–4)	<b>0.001</b>
Orientation	6	6 (6–6)	6 (6–6)	0.407
<b>The total score of MoCA</b>	<b>30</b>	<b>27 (26–28)</b>	<b>24 (19.5–26)</b>	<b>&lt;0.001</b>

Abbreviation: MoCA Montreal Cognitive Assessment

- Ασθενείς με διατηρημένη υπολειπόμενη νεφρική λειτουργία έχουν καλύτερη γνωστική λειτουργία, και καλύτερη ποιότητα ζωής.



Περιληπτικά...



- Πώς η *έναρξη* Αιμοκάθαρσης επηρεάζει τον Εγκέφαλο?  
*-Dialysis "shock"*

- Τί είναι η Σταδιακή (Incremental) Αιμοκάθαρση?  
*-Προοδευτική αύξηση της δόσης της κάθαρσης*

+

- Πώς επηρεάζει η Σταδιακή Αιμοκάθαρση τον εγκέφαλο?  
*-Μειώνει το στρες και πιθανώς την κατάθλιψη που σχετίζεται με την έναρξη, πιθανή συσχέτιση με διατήρηση γνωστικής λειτουργίας*

- Συσχετίζεται η Σταδιακή Αιμοκάθαρση με την διατήρηση της Υπολειπόμενης Νεφρικής Λειτουργίας?  
*-Ναι*

- Ποια είναι τα οφέλη της διατήρησης της Υπολειπόμενης Νεφρικής Λειτουργίας σε σχέση με τον Εγκέφαλο?  
*-Πιθανή διατήρηση της γνωστικής λειτουργίας, και της ποιότητας ζωής*

○



## Incremental Dialysis



## Personalized Dialysis

- Ευχαριστώ!



ΟΓΚΟΣ ΟΥΡΩΝ	2350
ΛΕΥΚΩΜΑ ΟΥΡΩΝ	174
ΝΑΤΡΙΟ ΟΥΡΩΝ	61
ΚΑΛΙΟ ΟΥΡΩΝ	15.82
ΚΡΕΑΤΙΝΙΝΗ ΟΥΡΩΝ	45.06
<b>ΟΥΡΙΑ ΟΥΡΩΝ</b>	<b>526.7</b>
ΛΕΥΚΩΜΑ ΟΥΡΩΝ 24h	408.9
ΝΑΤΡΙΟ ΟΥΡΩΝ 24h	143.35
ΚΑΛΙΟ ΟΥΡΩΝ 24h	37.177
ΚΡΕΑΤΙΝΙΝΗ ΟΥΡΩΝ 24h	1058.91
ΟΥΡΙΑ ΟΥΡΩΝ 24h	12377.45

ΟΥΡΙΑ	74.8	136.7
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- Όγκος ούρων 2350 ml
- Ουρία ορού 136.7 mg/dl
- Ουρία ούρων 526.9 mg/dl
- $2350 \text{ ml} \times (526.9 \text{ mg/dl} / 136.7 \text{ mg/dl}) / 1440 \text{ min} = 6,28 \text{ ml/min}$
- Εμείς θέλουμε το εβδομαδιαίο
- Πρέπει να μετατρέψουμε τα ml/min σε lit/week

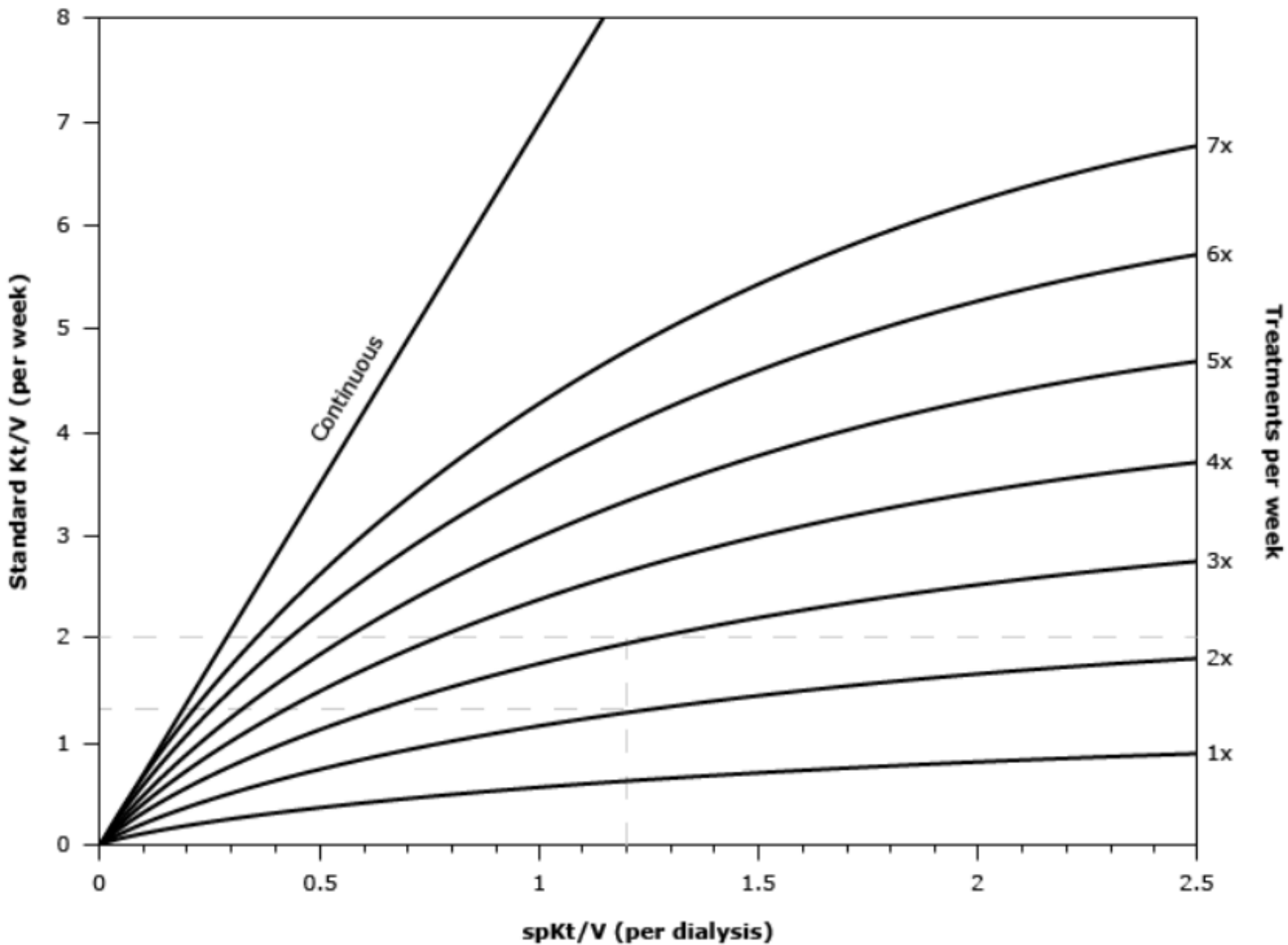
To obtain  $K_r t/V$ , one must calculate  $K_r$  (urea clearance/week),  $t$  (time), and  $V$ .

$K_r$  (liters/week) = Urea clearance (mL/min) x 10.08 (to convert mL/min to liters/week)

$t = 1 \text{ week}$

- $6.28 \times 10.08 = 63.3 \text{ lit/week}$
- Υπολογίζουμε το  $V$  από τον τύπο του Watson (π.χ. Online MedCalc κτλ).  $V = 39.53 \text{ Lit}$
- $Kt/V$  (υπολειπόμενης νεφρικής λειτουργίας) =  $63.3 \text{ lit/week} \times 1 \text{ week} / 39.53 \text{ Lit} = 1.6$

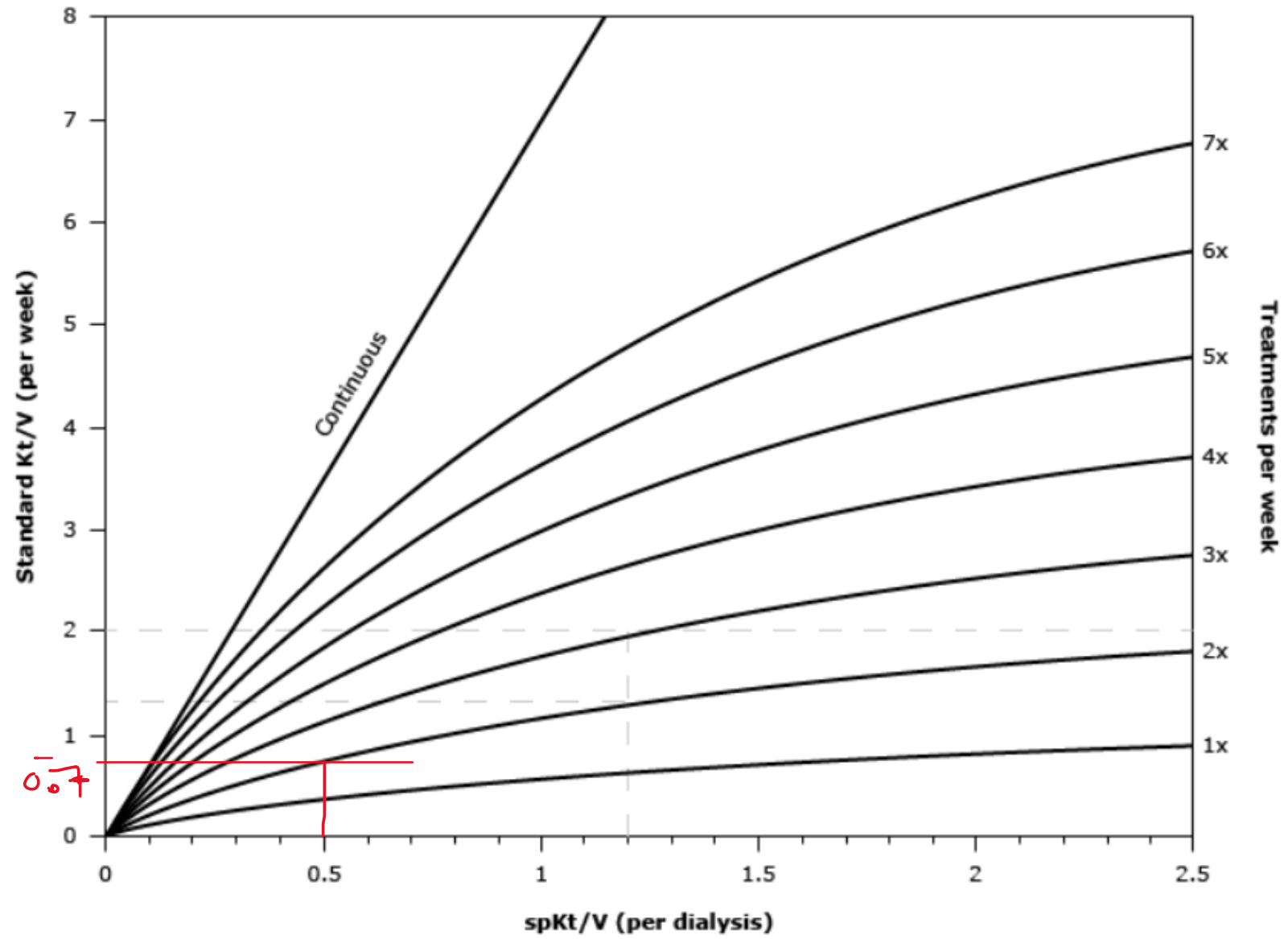
- Νεφρ
- Αφο
- στόχ
- ΚΔΟ
- Άρα, υπόλ



spKt/V: single-pool Kt/V.

πιτευχθεί ο

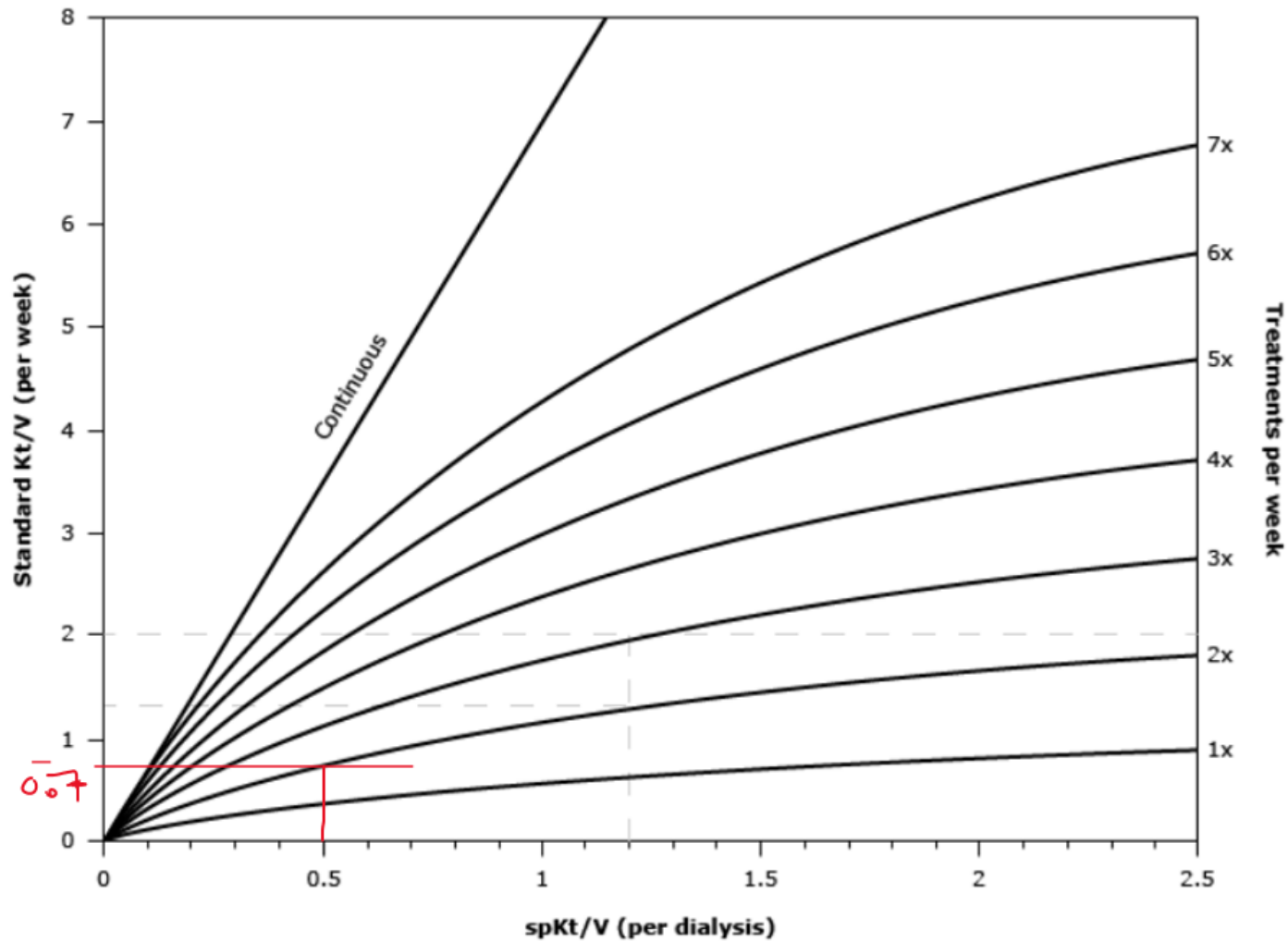
μοκάθαρση το



spKt/V: single-pool Kt/V.



SECTION TITLE



spKt/V: single-pool Kt/V.

Ο ασθενής έχει αποδιδόμενο  $spKt/V$  0.64  
 Άρα καλύπτεται με την υπάρχουσα δόση  
 κάθαρσης.

Clearance (*in vitro*)

		REXEED-13L			REXEED-15L		
Blood Flow (mL/min)		200	300	400	200	300	400
Clearances (mL/min) <sup>1)</sup>	Urea	192	255	291	195	265	305
	Creatinine	186	241	276	191	251	287
	Phosphate	147	175	192	157	191	205
	Vitamin B <sub>12</sub>	88	98	100	97	108	113
KoA (Urea)(mL/min) <sup>2)</sup>		888			1045		
KUF (mL/hr/mmHg (mL//hr/kPa)) <sup>3)</sup>		10 (75)			12 (90)		
Effectives Surface Area (m <sup>2</sup> )		1.3			1.5		

		REXEED-18L			REXEED-21L		
Blood Flow (mL/min)		200	300	400	200	300	400
Clearances (mL/min) <sup>1)</sup>	Urea	197	270	312	198	277	325
	Creatinine	192	256	297	195	268	314
	Phosphate	162	199	215	171	213	236
	Vitamin B <sub>12</sub>	103	117	122	115	128	136
KoA (Urea)(mL/min) <sup>2)</sup>		1145			1321		
KUF (mL/hr/mmHg (mL//hr/kPa)) <sup>3)</sup>		15 (113)			18 (135)		
Effectives Surface Area (m <sup>2</sup> )		1.8			2.1		

Conditions:

<sup>1)</sup> Clearances:  $Q_d=500\text{mL/min}$ ,  $Q_f=0\text{mL/min}$

<sup>2)</sup> KoA:  $Q_b=300\text{mL/min}$ ,  $Q_d=500\text{mL/min}$ ,  $Q_f=0\text{mL/min}$

<sup>3)</sup> KUF: bovine blood,  $TP=60\pm 5\text{g/L}$ ,  $Hct=32\pm 2\%$ ,

$Q_b=300\text{mL/min}$

ISO 8637:2004

$Kt/V$

$K$  = Clearance φίλτρου σε ml/min

$T$  = χρόνος σε min (π.χ. 2,5 ώρες ή 150 min)

$V$  = 39.530 ml

$K \ 150 / 39530=0.5 \rightarrow K= 0.5 \times 39530 \text{ ml} / 150 \text{ min} \rightarrow$

$K = 131 \text{ ml} / \text{min}$





# Residual Kidney Function (RKF) upon Transition and Dialysis Patients

## Therapeutic options

- Avoidance of nephrotoxins
- RAAS blockade
- BP control?
- Avoidance of hypovolemia
- ↓ Peritonitis in PD
- Low protein diet ?



## Benefits of RKF

- ↑ middle molecule & uremic toxins
- Maintenance of liquid balance
- Improved BP control & ↓ in LVH
- Endocrine: EPO, Ca<sup>2+</sup>, P, VMD1
- ↓ Malnutrition and inflammation
- ↓ Survival & quality of life

Am J Kidney Dis 52:1066-1061 (2009)


© K. Kalantar-Zadeh 2017 (in press)  
(Reprint of TC-CAD)

© K. Kalantar-Zadeh 2017






## Incremental HD prevented:

- 2.7 tonnes of non-recyclable waste.
- 56 tonnes of CO<sub>2</sub> being emitted.
- 496,000 litres of water for HD treatment.
- 40,274 miles from being travelled.
- 1,240 unnecessary HD treatments.



 **Jeff Perl** @PD\_Perls · Jul 10, 2020 ...

Kidney **REPLACEMENT** Therapy is a misnomer for Peritoneal Dialysis because it should work with a patient's **residual kidney function** I call it **Kidney Addition Therapy !!!** @ISPD1 @ASNKidney

 9       7       74            

# Use of incremental peritoneal dialysis: impact on clinical outcomes and quality of life measure

Mihran Najjayan<sup>1 2</sup>, Abigail Hunt<sup>3 4</sup>, Katherine McKeon<sup>3 4</sup>, Gilbert Marlowe<sup>3 4</sup>, Martin J Schreiber<sup>3 4</sup>, Steven M Brunelli<sup>3 4</sup>, Francesca Tentori<sup>5 6</sup>

Affiliations + expand

PMID: 37644364 DOI: 10.1007/s40620-023-01703-y

## Abstract

**Background:** Incremental peritoneal dialysis (PD) can be defined as a PD prescription that is less than the standard, full dose prescription and is typically used for patients initiating PD with residual kidney function. It has been suggested that use of incremental peritoneal dialysis may help preserve residual kidney function and may offer better quality of life due to the lower treatment burden, however published evidence is limited. In this study we assessed the associations between incremental peritoneal dialysis use and both clinical outcomes and quality of life measures in a large cohort of incident peritoneal dialysis patients in the US.

**Methods:** We considered adult patients initiating peritoneal dialysis between 31 July, 2015 and 31 May, 2019 within a single dialysis organization. Patients with body weight < 40 kg, amputation, or an estimated glomerular filtration rate > 20 mL/min during the first 4 weeks on peritoneal dialysis were excluded. Patients were assigned to exposure groups based on peritoneal dialysis prescription during dialysis weeks 5-8. Incremental peritoneal dialysis was defined by treatment frequency, number of exchanges/day, and exchange volume (for continuous ambulatory peritoneal dialysis patients) or by treatment frequency and presence/absence of last fill (for automated peritoneal dialysis patients). Analyses were performed separately for continuous ambulatory peritoneal dialysis and automated peritoneal dialysis. For each analysis, incremental peritoneal dialysis patients were propensity score matched to eligible full-dose peritoneal dialysis patients. Patients were followed for a maximum of 12 months until censoring for loss to follow-up or study end. Outcomes were compared using Poisson models (mortality, hospitalization, peritoneal dialysis discontinuation), linear mixed models (estimated glomerular filtration rate), and paired t tests (KDQOL domain scores).

**Results:** Among continuous ambulatory peritoneal dialysis patients, compared to full-dose peritoneal dialysis, incremental peritoneal dialysis use was associated with better KDQOL scores on 3 domains: physical composite score (42.5 vs 37.7,  $p = 0.03$ ), burden of kidney disease (60.2 vs 45.6,  $p = 0.003$ ), effects of kidney disease (79.4 vs 72.3,  $p = 0.05$ ). Hospitalization and mortality rates were numerically lower (0.77 vs 1.12 admits/pt-year,  $p = 0.09$  and 5.0 vs 10.2 deaths/100 pt-years,  $p = 0.22$ ), while no associations were found with estimated glomerular filtration rate or peritoneal dialysis discontinuation rate. Use of incremental peritoneal dialysis was not associated with any discernable effects on outcomes in automated peritoneal dialysis patients.

**Conclusion:** These results suggest that there may be benefits of using incremental PD in the context of continuous ambulatory peritoneal dialysis, particularly with respect to quality of life as a prescription strategy when initiating peritoneal dialysis. While no significant benefits of incremental peritoneal dialysis were detected among patients initiating automated peritoneal dialysis, no detrimental effects of using incremental schedules were observed for either peritoneal dialysis type.

> Clin J Am Soc Nephrol. 2023 Aug 23. doi: 10.2215/CJN.0000000000000281. Online ahead of print.



# Delivering Person-Centered Peritoneal Dialysis

PRESENTATION TITLE

Richard W Corbett <sup>1</sup>, Hannah Beckwith <sup>2</sup>, Gaetano Lucisano <sup>1</sup>, Edwina A Brown <sup>1</sup>

Affiliations + expand

PMID: 37611155 DOI: 10.2215/CJN.0000000000000281

## Abstract

Peritoneal dialysis (PD) enables people to have a home-based therapy, permitting greater autonomy for individuals along with enhanced treatment satisfaction compared with in-center dialysis care. The burden of treatment on PD, however, remains considerable and underpins the need for person-centered care. This reflects the need to address the patient as a person with needs and preferences beyond just the medical perspective. Shared decision making is central to the recent International Society for Peritoneal Dialysis recommendations for prescribing PD, balancing the potential benefits of PD on patient well-being with the burden associated with treatment. This review considers the role of high-quality goal-directed prescribing, incremental dialysis, and remote patient monitoring in reducing the burden of dialysis, including an approach to implementing incremental PD. Although patient-related outcomes are important in assessing the response to treatment and, particularly life participation, the corollary of dialysis burden, there are no clear routes to the clinical implementation of patient-related outcome measures. Delivering person-centered care is dependent on treating people both as individuals and as equal partners in their care.

## On the path to individualizing care with incremental-start hemodialysis

Mariana Murea<sup>1</sup>, Eugene Lin<sup>2</sup>, Massimo Torreggiani<sup>3</sup>

Affiliations + expand

PMID: 37289367 DOI: 10.1007/s40620-023-01689-7

## Incremental peritoneal dialysis: Is it better for preservation of residual kidney function and clinical outcomes?

Adriana Fernandes, Patrícia Matias, Patrícia Branco

PMID: 36472405 DOI: 10.5414/CN110958

### Abstract

**Introduction:** Incremental peritoneal dialysis (IPD) is based on the prescription of a dose lower than the standard (SPD). The combination of residual kidney function (RKF) and peritoneal clearance achieves clearance goals. The aim of this study is to compare the outcomes of IPD with SPD.

**Materials and methods:** This was a single-center, retrospective study that included a cohort of prevalent peritoneal dialysis (PD) adults. Patients were assigned according to their first PD protocol in two groups - group A: IPD protocol (continuous ambulatory PD: less than 4 dwells daily, less than 2 L dwell volume, and/or treatment less than 7 days/week; automated PD: without a long dwell, less than 10 L daily delivered, and/or treatment for less than 7 days/week); group B: SPD protocol.

**Results:** 87 PD patients were included, 65.5% underwent IPD. The median follow-up time was 23 months (IQR 15 - 35). IPD had a higher glomerular filtration ratio (7 vs. 3.7, mL/min/1.73m<sup>2</sup>, p < 0.001) in the first 6 months, and after 24 months (4.8 vs. 1.9, mL/min/1.73m<sup>2</sup>, p = 0.002). IPD protocol was independently associated with GFR ≥ 5 mL/min/1.73m<sup>2</sup> at 24 months (OR 13 per point, 95% CI 1.48 - 114.36, p = 0.021). IPD was also associated with a longer technique survival (log-rank test = 4.928, p = 0.026), lower hospital admissions per year (0.23 vs. 0.5, p = 0.001), and lower mortality (1.8% vs. 13.3%, p = 0.027). Cox regression demonstrated that IPD (HR 0.30; 95% CI 0.098 - 0.93); p = 0.036) was associated with a decrease in the risk of technique failure.

**Conclusion:** The prescription of IPD seems to be beneficial, in terms of outcomes, for patients with substantial RKF.

## Incremental Peritoneal Dialysis-Definition, Prescription, and Clinical Outcomes

Adriana Fernandes<sup>1</sup>, Patrícia Matias<sup>2</sup>, Patrícia Branco<sup>2</sup>

Affiliations + expand

PMID: 36821618 PMCID: PMC10103348 DOI: 10.34067/KID.0006902022

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### Abstract

Incremental peritoneal dialysis (IPD) is a strategy of RRT that is based on the prescription of a lower dose rather than the standard full dose of peritoneal dialysis (PD). The clearance goals are achieved through the combination of residual kidney function (RKF) and peritoneal clearance. The dialysis prescription should be increased as the RKF declines. IPD has been associated with clinical, economic, and environmental advantages. We emphasize possible better quality of life, fewer mechanical symptoms, lower costs, slight adverse metabolic effects, and less plastic waste and water consumption. The potential benefits for RKF preservation and the lower risk of peritonitis have also been discussed. There are some concerns regarding this strategy, such as inadequate clearance of uremic toxins and/or severe electrolyte disturbances due to undetected loss of RKF, lower clearance of medium-sized molecules (such as β-2-microglobulin) which mostly depends on the total PD dwell time, and patients' reluctance to dose adjustments. Current clinical evidence is based on moderate-quality to low-quality studies and suggests that the outcomes of IPD will be at least identical to those of full dose. This review aims to define IDP, discuss strategies for prescription, and review its advantages and disadvantages according to the current evidence.



TION TITLE

# Towards a tailored prescription of dialysis adequacy: the key role of incremental haemodialysis

Carlo Basile<sup>1</sup>, Francesco Gaetano Casino<sup>2</sup>, Sandip Mitra<sup>3</sup>;  
EuDial Working Group of the European Renal Association

Affiliations + expand

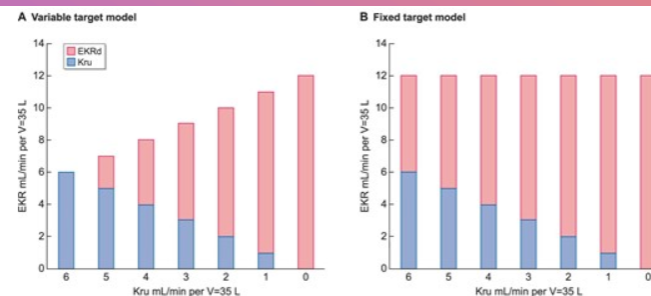
PMID: 36208159 DOI: 10.1093/ndt/gfac281

progressively increased to compensate for any subsequent reduction in RKF. The current principle for calculating the amount of dialysis required to compensate for RKF reduction is based on the constancy of a given target value of total (renal + dialytic) equivalent continuous weekly clearance, as expressed by the equivalent continuous clearance (ECC) of urea. The above principle has been advocated by both the Kidney Disease Outcomes Quality Initiative (KDOQI) [3] and European Best Practice guidelines [4].

Two versions of ECC exist, the standard Kt/V (stdKt/V), i.e. the pre-dialysis averaged concentration (PAC)-based ECC [6], and the time averaged concentration (TAC)-based ECC (EKR) [7]. The assumption of a constancy of the total ECC (renal + dialytic), the so-called fixed target model (FTM), necessarily implies perfect clinical equivalence between the dialysis urea clearance (Kd) and the residual renal urea clearance (Kru) [8]. This assumption is incorrect because Kru has a much greater clinical weight than Kd, in agreement with basic physiology [9]. The assumption is derived from extrapolation to the clinical domain of the equivalence between Kru and Kd in the UKM, in which 1 ml/min of RKF, represented by Kru, removes the same amount of urea as 1 ml/min of Kd [10]. A 'variable target model' (VTM) has recently been introduced to overcome the limitations of the FTM [8]. The total EKR is given by the sum of Kd and Kru. According to the FTM, the total target EKR in a patient with a urea distribution volume (V) of 35 L should remain constant:

total EKR = 12 mL/min/35 L

or approximately 1.2 equilibrated Kt/V (eKt/V) × 3 sessions/week (Fig. 1) [8]. This means that each ml/min of Kru should be replaced by increasing the dialysis component (EKrd) by the same amount.



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Total EKR expresses the total clearance (dialytic + renal), i.e. the sum of the contribution of the dialyser urea clearance (Kd) to EKR (EKrd) and of the residual renal urea clearance (Kru). According to the FTM, the total target EKR should remain constant: 12 mL/min/35 L. This means that each mL/min of Kru should be replaced by increasing EKrd by the same amount. In contrast, according to the VTM, the total target EKR is 12 mL/min/35 L - Kru, i.e. it varies from a minimum value at the start of HD treatment (in this case Kru = 6 mL/min/35 L) to a maximum value when Kru = 0 (modified from Figure 1 of reference [15]).

In contrast, according to the VTM, the total target EKR is:

total EKR = 12 mL/min/35 L - Kru mL/min/35 L,

that is, it varies from a minimum value at the start of HD treatment (in this case Kru = 6 mL/min/35 L) to a maximum value when Kru = 0. This value corresponds to the adequate eKt/V in an anuric patient on a thrice-weekly HD regimen (Fig. 1) [8]. Of note, a total EKR of 12 and 10 in an anuric patient corresponds to a stdKt/V of 2.3 and 2.1, respectively, which are the target value and the minimum value, respectively, advised by the KDOQI guidelines [4]. This leads to an overestimation of dialysis needs in the presence of substantial RKF, requiring achievement of such high values



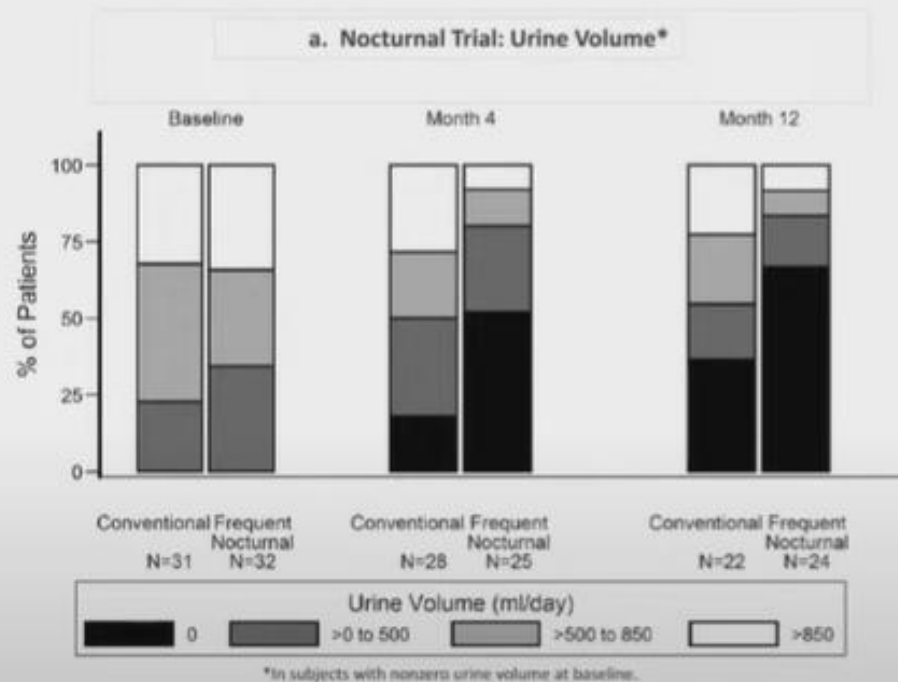
PRESENTATION TITLE

regimen (G2) and 39 (19.3%) with a 3 HD sessions/week regimen (G3). All patients underwent a monthly urea kinetic study with urine output measurements, if any. The treatment frequency was increased in the presence of a marked reduction in Kru and/or the appearance of 'uraemic' symptoms or signs not treatable with medical therapy [11]. G1 patients remained on 1 HD session/week for 11.9 ± 14.8 months and then transferred to 2 HD sessions/week for a further 13.0 ± 20.3 months. G2 patients remained on 2 HD sessions/week for 16.7 ± 23.2 months. Altogether, 22 045 sessions were saved of the 47 988 that would have been delivered if the patients had been on a 3 HD sessions/week regimen (45.9%). Gross mortality of the entire group was 12.6%, comparable to the mean mortality of the Italian dialysis population (16.2%) [11]. This observational study resembles the intervention arm of an RCT of incremental HD that demonstrated nearly 81% of patients could be started on a less frequent treatment that could be maintained for 1–2 years, with clinical and financial benefits and no increase in mortality risk [11]. On this basis, one could suggest trying to start all clinically stable patients on 1 or 2 HD sessions/week and stay on that regimen only if RKF and diuresis are maintained in the absence of uraemic symptoms and/or signs.

Arguably, further RCTs are needed to demonstrate the safety and clinical efficacy of the incremental approach. Only two RCTs have been completed, perhaps indicating the challenges in performing an RCT on this topic [12, 13]. Notably, the first one was a feasibility study and concluded that a large and definitive trial comparing the outcomes of the incremental (2 HD sessions/week) vs the standard approach is feasible, safe and requires lower financial costs in patients with sufficient RKF [12].

Some RCTs are planned or ongoing. Of note, a Spanish-Italian RCT (already underway) [14] and an RCT planned by the EuDial Working Group of the European Renal Association (REAL LIFE) [15] were designed to evaluate the adequacy of incremental HD (1 and 2 HD sessions/week) compared with the standard thrice-weekly HD by using the VTM [8].

# Frequent HD regimes may result in loss of residual kidney function (RKF)



## Loss of RKF in nocturnal HD:

Data from the Frequent Haemodialysis Network: In the **frequent** dialysis group, urine volume had declined to zero in 52% and 67% of patients at months 4 and 12, respectively, compared with 18% and 36% in controls



TITLE

Review > Am J Kidney Dis. 2023 Jan;81(1):100-109. doi: 10.1053/j.ajkd.2022.07.004.

Epub 2022 Oct 5.

## Peritoneal Dialysis Prescription and Adequacy in Clinical Practice: Core Curriculum 2023

Bourne L Auguste<sup>1</sup>, Joanne M Bargman<sup>2</sup>

Affiliations + expand

PMID: 36208963 DOI: 10.1053/j.ajkd.2022.07.004

### Abstract

As the global prevalence of peritoneal dialysis (PD) continues to grow, practitioners must be equipped with prescribing strategies that focus on the needs and preferences of patients. PD is an effective form of kidney replacement therapy that offers numerous benefits to patients, including more flexibility in schedules compared with in-center hemodialysis (HD). Additional benefits of PD include salt and water removal without significant changes in patient hemodynamics. This continuous yet gentle removal of solutes and fluid is associated with better-preserved residual kidney function. Unfortunately, sometimes these advantages are overlooked at the expense of an emphasis on achieving small solute clearance targets. A more patient-centered approach emphasizes the importance of individualized treatment, particularly when considering incremental PD and other prescriptions that align with lifestyle preferences. In shifting the focus from small solute clearance targets to patient needs and clinical goals, PD remains an attractive, patient-centered form of kidney replacement therapy.

Randomized Controlled Trial > BMC Nephrol. 2022 Sep 27;23(1):322.

doi: 10.1186/s12882-022-02946-w.

## Patient-reported outcomes in a pilot clinical trial of twice-weekly hemodialysis start with adjuvant pharmacotherapy and transition to thrice-weekly hemodialysis vs conventional hemodialysis

Mariana Murea<sup>1</sup>, Benjamin R Highland<sup>2</sup>, Wesley Yang<sup>2</sup>, Emily Dressler<sup>3</sup>, Gregory B Russell<sup>3</sup>

Affiliations + expand

PMID: 36167537 PMCID: PMC9513956 DOI: 10.1186/s12882-022-02946-w

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### Abstract

**Background:** Physical and emotional symptoms are prevalent in patients with kidney-dysfunction requiring dialysis (KDRD) and the rigors of thrice-weekly hemodialysis (HD) may contribute to deteriorated health-related quality of life. Less intensive HD schedules might be associated with lower symptom and/or emotional burden.

**Methods:** The TWOPUS Pilot study was an individually-randomized trial conducted at 14 dialysis units, with the primary goal to assess feasibility and safety. Patients with incident KDRD and residual kidney function were assigned to incremental HD start (twice-weekly HD for 6 weeks followed by thrice-weekly HD) vs conventional HD (thrice-weekly HD). In exploratory analyses, we compared the two treatment groups with respect to three patient-reported outcomes measures. We analyzed the change from baseline in the score on Dialysis Symptom Index (DSI, range 0-150), Generalized Anxiety Disorder-7 (GAD-7, range 0-21), and Patient Health Questionnaire-9 (PHQ-9, range 0-27) at 6 (n = 20 in each treatment group) and 12 weeks (n = 21); with lower scores denoting lower symptom burden. Analyses were adjusted for age, race, gender, baseline urine volume, diabetes mellitus, and malignancy. Participants' views on the intervention were sought using a Patient Feedback Questionnaire (n = 14 in incremental and n = 15 in conventional group).

**Results:** The change from baseline to week 6 in estimated mean score (standard error; P value) in the incremental and conventional group was - 9.7 (4.8; P = 0.05) and - 13.8 (5.0; P = 0.009) for DSI; - 1.9 (1.0; P = 0.07) and - 1.5 (1.4; P = 0.31) for GAD-7; and - 2.5 (1.1; P = 0.03) and - 3.5 (1.5; P = 0.02) for PHQ-9, respectively. Corresponding changes from week 6 to week 12 were - 3.1 (3.2; P = 0.34) and - 2.4 (5.5; P = 0.67) in DSI score; 0.5 (0.6; P = 0.46) and 0.1 (0.6; P = 0.87) in GAD-7 score; and - 0.3 (0.6; P = 0.70) and - 0.5 (0.6; P = 0.47) in PHQ-9 score, respectively. Majority of respondents felt their healthcare was not jeopardized and expressed their motivation for study participation was to help advance the care of patients with KDRD.

**Conclusions:** This study suggests a possible mitigating effect of twice-weekly HD start on symptoms of anxiety and depression at transition from pre-dialysis to KDRD. Larger clinical trials are required to rigorously test clinically-matched incrementally-prescribed HD across diverse organizations and patient populations.



Meta-Analysis > Nephrol Dial Transplant. 2023 Feb 13;38(2):435-446. doi: 10.1093/ndt/gfac274.

## Impact of incremental initiation of haemodialysis on mortality: a systematic review and meta-analysis

Emma Caton <sup>1</sup>, Shivani Sharma <sup>1</sup>, Enric Vilar <sup>1 2</sup>, Kenneth Farrington <sup>1 2</sup>

Affiliations + expand

PMID: 36130107 PMID: PMC9923704 DOI: 10.1093/ndt/gfac274

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### Abstract

**Background:** Incremental haemodialysis initiation entails lower sessional duration and/or frequency than the standard 4 h thrice-weekly approach. Dialysis dose is increased as residual kidney function (RKF) declines. This systematic review evaluates its safety, efficacy and cost-effectiveness.

**Methods:** We searched MEDLINE, EMBASE, CINAHL and the Cochrane Library databases from inception to 27 February 2022. Eligible studies compared incremental haemodialysis (sessions either fewer than three times weekly or of duration <3.5 h) with standard treatment. The primary outcome was mortality. Secondary outcomes included treatment-emergent adverse events, loss of RKF, quality of life and cost effectiveness. The study protocol was prospectively registered. Risk of bias assessment used the Newcastle-Ottawa Scale and the revised Cochrane risk of bias tool, as appropriate. Meta-analyses were undertaken in Review Manager, Version 5.4.

**Results:** A total of 644 records were identified. Twenty-six met the inclusion criteria, including 22 cohort studies and two randomized controlled trials (RCTs). Sample size ranged from 48 to 50 596 participants (total 101 476). We found no mortality differences (hazard ratio = 0.99; 95% CI 0.80-1.24). Cohort studies suggested similar hospitalization rates though the two small RCTs suggested less hospitalization after incremental initiation (relative risk = 0.31; 95% CI 0.18-0.54). Data on other treatment-emergent adverse events and quality of life was limited. Observational studies suggested reduced loss of RKF in incremental haemodialysis. This was not supported by RCT data. Four studies reported reduced costs of incremental treatments.

**Conclusions:** Incremental initiation of haemodialysis does not confer greater risk of mortality

Review > J Nephrol. 2022 Dec;35(9):2191-2204. doi: 10.1007/s40620-022-01388-9.

Epub 2022 Jul 11.

## On the importance of the interplay of residual renal function with clinical outcomes in end-stage kidney disease

Cem Tanriover <sup>1</sup>, Duygu Ucku <sup>1</sup>, Carlo Basile <sup>2</sup>, Katherine R Tuttle <sup>3 4</sup>, Mehmet Kanbay <sup>5</sup>

Affiliations + expand

PMID: 35819749 DOI: 10.1007/s40620-022-01388-9

### Abstract

Chronic kidney disease (CKD) is one of the most important public health concerns of the century, and is associated with high rates of morbidity, mortality and social costs. CKD evolving towards end-stage kidney disease (ESKD) is on the rise resulting in a greater number of patients requiring peritoneal dialysis (PD) and hemodialysis (HD). The aim of this manuscript is to review the current literature on the interplay of residual renal function (RRF) with clinical outcomes in ESKD. The persistence of RRF is one of the most important predictors of decreased morbidity, mortality, and better quality of life in both PD and HD patients. RRF contributes to the well-being of ESKD patients through various mechanisms including higher clearance of solutes, maintenance of fluid balance, removal of uremic toxins and control of electrolytes. Furthermore, RRF has beneficial effects on inflammation, anemia, malnutrition, diabetes mellitus, obesity, changes in the microbiota, and cardiac diseases. Several strategies have been proposed to preserve RRF, such as blockade of the renin-angiotensin-aldosterone system, better blood pressure control, incremental PD and HD. Several clinical trials investigating the issue of preservation of RRF are ongoing. They are needed to broaden our understanding of the interplay of RRF with clinical outcomes in ESKD.



ARTICLE TITLE

# Incremental and Personalized Hemodialysis Start: A New Standard of Care

Massimo Torreggiani<sup>1</sup>, Antioco Fois<sup>1</sup>, Antoine Chatre<sup>1 2</sup>, Louise Nielsen<sup>1 3</sup>, Lurlynis Gendrot<sup>1 4</sup>, Elisa Longhitano<sup>1 5</sup>, Léna Lecointre<sup>6</sup>, Claudine Garcia<sup>1</sup>, Conrad Breuer<sup>6</sup>, Béatrice Mazé<sup>1</sup>, Assia Hami<sup>7</sup>, Guillaume Seret<sup>8</sup>, Patrick Saulniers<sup>9</sup>, Pierre Ronco<sup>1 10</sup>, Frederic Lavainne<sup>3</sup>, Giorgina Barbara Piccoli<sup>1</sup>

Affiliations + expand

PMID: 35571001 PMID: PMC9091804 DOI: 10.1016/j.ekir.2022.02.010

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## Abstract

**Introduction:** Incremental hemodialysis (iHD) may attenuate "dialysis shock" and reduce costs, preserving quality of life. It is considered difficult to reconcile with HD wards' routine; fear of underdialysis and increasing mortality are additional concerns. The aim of this study was to evaluate mortality, morbidity, and costs in a large HD ward where iHD is the standard of HD start.

**Methods:** This observational study included all incident HD patients in 2017 to 2021, stratified according to HD start: iHD (1-2 sessions/wk), decremental HD (dHD, 3 sessions/wk at start, later reduced), or standard (3 sessions/wk). Results were compared with data recorded in the same unit before the incremental program (2015-2017) and with a propensity score-matched cohort from the French Renal Epidemiology and Information Network (REIN) registry.

**Results:** A total of 158 patients started HD in 2017 to 2021, 57.6% on iHD, 8.9% dHD, and 33.5% standard HD schedule. Patients on the standard schedule had lower initial estimated glomerular filtration rate (eGFR) (5 vs. 7 ml/min per 1.72 m<sup>2</sup>, *P* = 0.003). We found no survival differences according to period of start (same center) and propensity score matching (REIN). Patients intensively followed in the pre-HD period were more likely to start on iHD-dHD. Persistence on iHD-dHD was about 50% at 1 year and 35% at 2 years. Hospitalization rates and time to first hospitalization or death did not differ between the schedules. The iHD-dHD policy allowed a 16% cost saving, even accounting for supplemental biochemical tests.

**Conclusion:** Our study reveals that iHD can be a new standard of care, as it is safe and feasible in up to two-thirds of patients on incident HD.

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# Dialysis initiation, modality choice, access, and prescription: conclusions from a Kidney Disease: Improving Global Outcomes (KDIGO) Controversies Conference



OPEN

Christopher T. Chan<sup>1</sup>, Peter J. Blankestijn<sup>2</sup>, Laura M. Dember<sup>3</sup>, Maurizio Gallieni<sup>4</sup>, David C.H. Harris<sup>5</sup>, Charmaine E. Lok<sup>1</sup>, Rajnish Mehrotra<sup>6</sup>, Paul E. Stevens<sup>7</sup>, Angela Yee-Moon Wang<sup>8</sup>, Michael Cheung<sup>9</sup>, David C. Wheeler<sup>10</sup>, Wolfgang C. Winkelmayer<sup>11</sup> and Carol A. Pollock<sup>5</sup>; for Conference Participants<sup>12</sup>

<sup>1</sup>University Health Network, University of Toronto, Ontario, Canada; <sup>2</sup>Department of Nephrology and Hypertension, University Medical Center Utrecht, Utrecht, The Netherlands; <sup>3</sup>Renal-Electrolyte and Hypertension Division, Perelman School of Medicine, University of Pennsylvania, Philadelphia, Pennsylvania, USA; <sup>4</sup>Department of Clinical and Biomedical Sciences "Luigi Sacco", University of Milan, Milan, Italy; <sup>5</sup>University of Sydney, Sydney, NSW, Australia; <sup>6</sup>Division of Nephrology, Kidney Research Institute and Harborview Medical Center, University of Washington, Seattle, Washington, USA; <sup>7</sup>Kent Kidney Care Centre, East Kent Hospitals, University NHS Foundation Trust, Canterbury, Kent, UK; <sup>8</sup>Department of Medicine, Queen Mary Hospital, University of Hong Kong, Hong Kong, China; <sup>9</sup>KDIGO, Brussels, Belgium; <sup>10</sup>University College London, London, UK; and <sup>11</sup>Selzman Institute for Kidney Health, Section of Nephrology, Department of Medicine, Baylor College of Medicine, Houston, Texas, USA

PRESENTATION TITLE

[Kidney Int Rep.](#) 2020 Feb; 5(2): 135–148.

PMCID: PMC7000841

Published online 2019 Dec 6. doi: [10.1016/j.ekir.2019.11.014](https://doi.org/10.1016/j.ekir.2019.11.014)

PMID: [32043027](https://pubmed.ncbi.nlm.nih.gov/32043027/)

## Narrative Review of Incremental Hemodialysis

[Mariana Murea](#),<sup>1,\*</sup> [Shahriar Moossavi](#),<sup>1</sup> [Liliana Garneata](#),<sup>2</sup> and [Kamyar Kalantar-Zadeh](#)<sup>3</sup>

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# Incremental Hemodialysis: What We Know so Far

Vivek Soi<sup>1 2</sup>, Mark D Faber<sup>1 2</sup>, Ritika Paul<sup>1</sup>

Affiliations + expand

PMID: 35520631 PMID: PMC9065374 DOI: 10.2147/IJNRD.S286947

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## Abstract

Traditionally, patients that develop progressive chronic kidney disease in need of kidney replacement therapy are prescribed thrice weekly in-center hemodialysis sessions at the beginning of therapy. This empiric prescription is based on historic trials that were comprised of mostly prevalent patients. Incremental hemodialysis is the process of performing <3 sessions of dialysis per week or limiting dialysis dose by duration at the initial onset of treatment to provide a more gradual transition, mimicking the progressive nature of kidney disease. Adding clearance contributions from residual kidney function is the standard of care with peritoneal dialysis but has not routinely been employed with hemodialysis. Accounting for residual kidney function accompanied by improvement in adjuvant pharmacotherapy, such as newer potassium binding agents and dietary modification, can augment dialytic clearances and allow for an incremental approach. Utilizing incremental dialysis has been associated with both preserving residual kidney function as well as improving patient quality of life. Barriers to this approach include concerns regarding patient acceptance of dialysis prescription changes, adherence to therapy, and provider factors that would require a restructuring of the current thrice weekly hemodialysis rubric. Candidacy for incremental therapy has shown the best outcomes when urea clearances exceed 3 mL/min and urine volumes are >500 mL/day, although these measures have been deemed conservative. A significant amount of retrospective and registry data has been supportive of initiating incremental hemodialysis and several pilot studies have shown the feasibility of implementing such an approach. Larger, randomized control trials are needed to fully evaluate safety and efficacy to allow for more widespread acceptance of this patient-centered approach to chronic kidney disease.



PRESENTATION TITLE



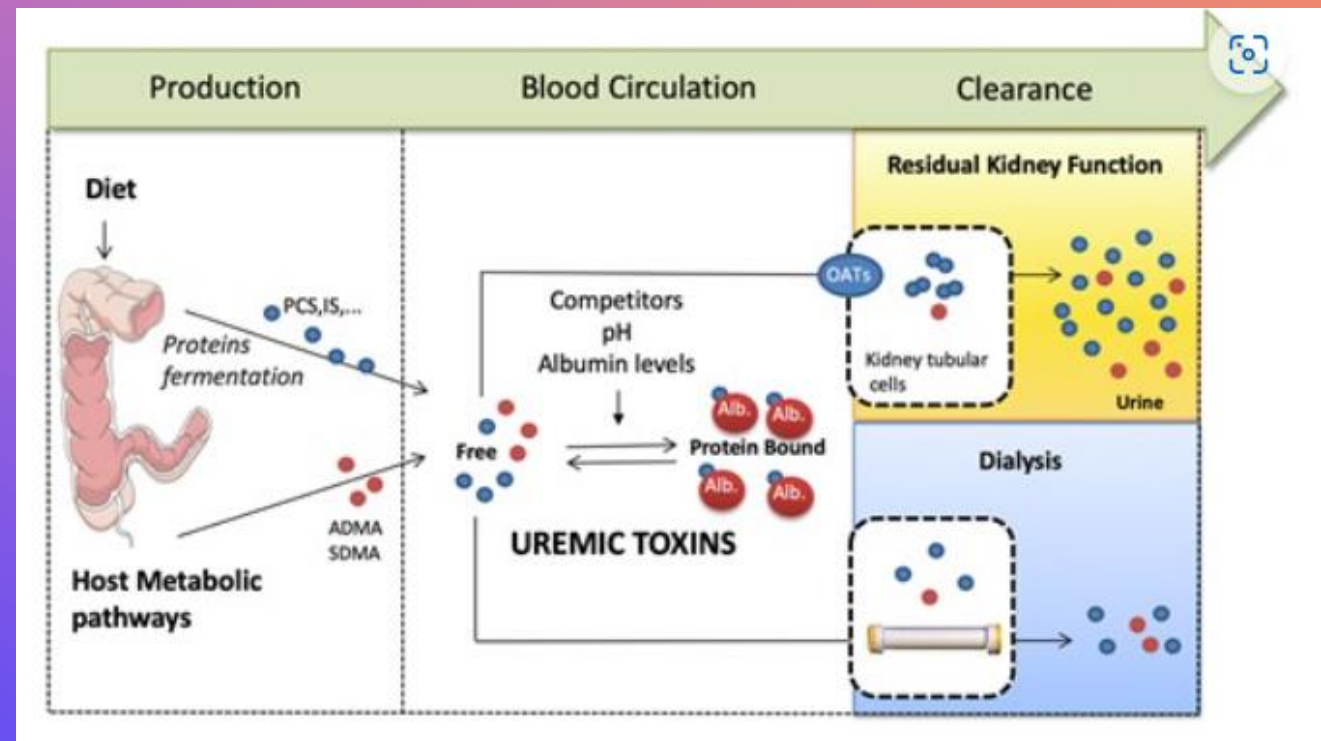
JOURNAL ARTICLE

# Contribution of 'clinically negligible' residual kidney function to clearance of uremic solutes FREE

Stephanie M Toth-Manikowski ✉, Tammy L Sirich, Timothy W Meyer, Thomas H Hostetter, Seungyoung Hwang, Natalie S Plummer, Xin Hai, Josef Coresh, Neil R Powe, Tariq Shafi

*Nephrology Dialysis Transplantation*, Volume 35, Issue 5, May 2020, Pages 846–853, <https://doi.org/10.1093/ndt/gfz042>

PRESENTATION TITLE





Edgar V. Lerma 🇵🇪 @edgarvlermamd · Mar 11, 2020

Replying to @edgarvlermamd

Why does **residual kidney function** decline faster with hemodialysis (HD) as compared to peritoneal dialysis (PD)?!

Slides courtesy of @JoanneBargman  
#Nephpearls #NephJC



PRESENTATION TITLE



*Residual kidney function should be determined for all individuals doing PD and management should focus on preserving this function (practice point).*



## Rapid Decline of Residual Kidney Function in Hemodialysis Patients

The “Usual” explanations

- Exposure of blood to the circuit leads to generation of inflammatory cytokines
- Sudden drops in blood pressure are repeated insults to the kidneys

## Rapid Decline of Residual Kidney Function in Hemodialysis Patients

Another explanation

- A patient with residual good urine output may come to hemodialysis at their target weight
- If we ultrafilter these patients repeatedly, they will be chronically volume depleted and lose their kidney function faster

[Ther Clin Risk Manag.](#) 2021; 17: 1177–1186.

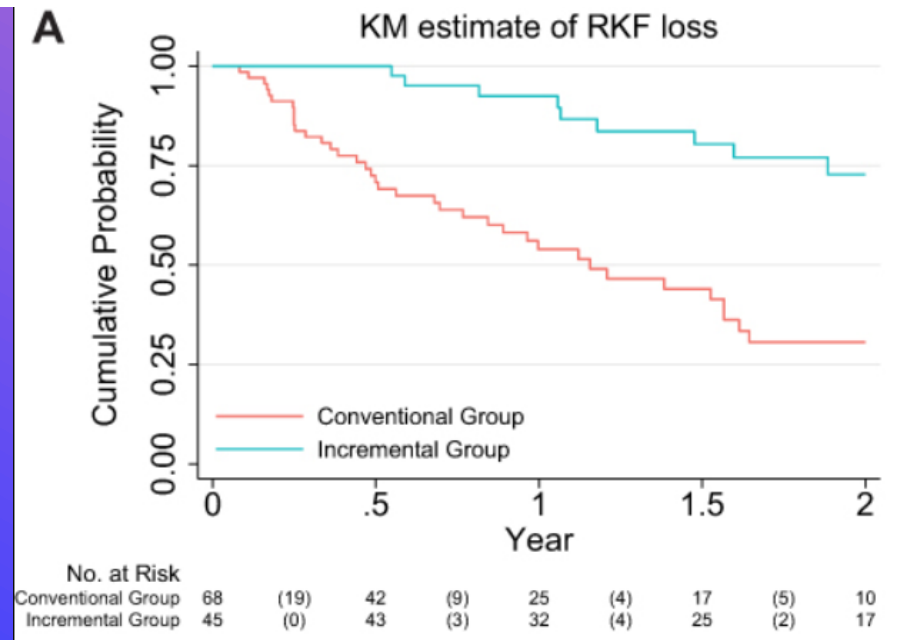
PMCID: PMC8598204

Published online 2021 Nov 13. doi: [10.2147/TCRM.S332218](https://doi.org/10.2147/TCRM.S332218)

PMID: [34803381](https://pubmed.ncbi.nlm.nih.gov/34803381/)

## Benefits of Incremental Hemodialysis Seen in a Historical Cohort Study

[Weisheng Chen](#),<sup>1</sup> [Mengjing Wang](#),<sup>1,2</sup> [Minmin Zhang](#),<sup>1</sup> [Weichen Zhang](#),<sup>1</sup> [Jun Shi](#),<sup>1</sup> [Jiamin Weng](#),<sup>1</sup> [Bihong Huang](#),<sup>1</sup>  
[Kamyar Kalantar-Zadeh](#),<sup>3,4,5</sup> and [Jing Chen](#)<sup>1,2</sup>





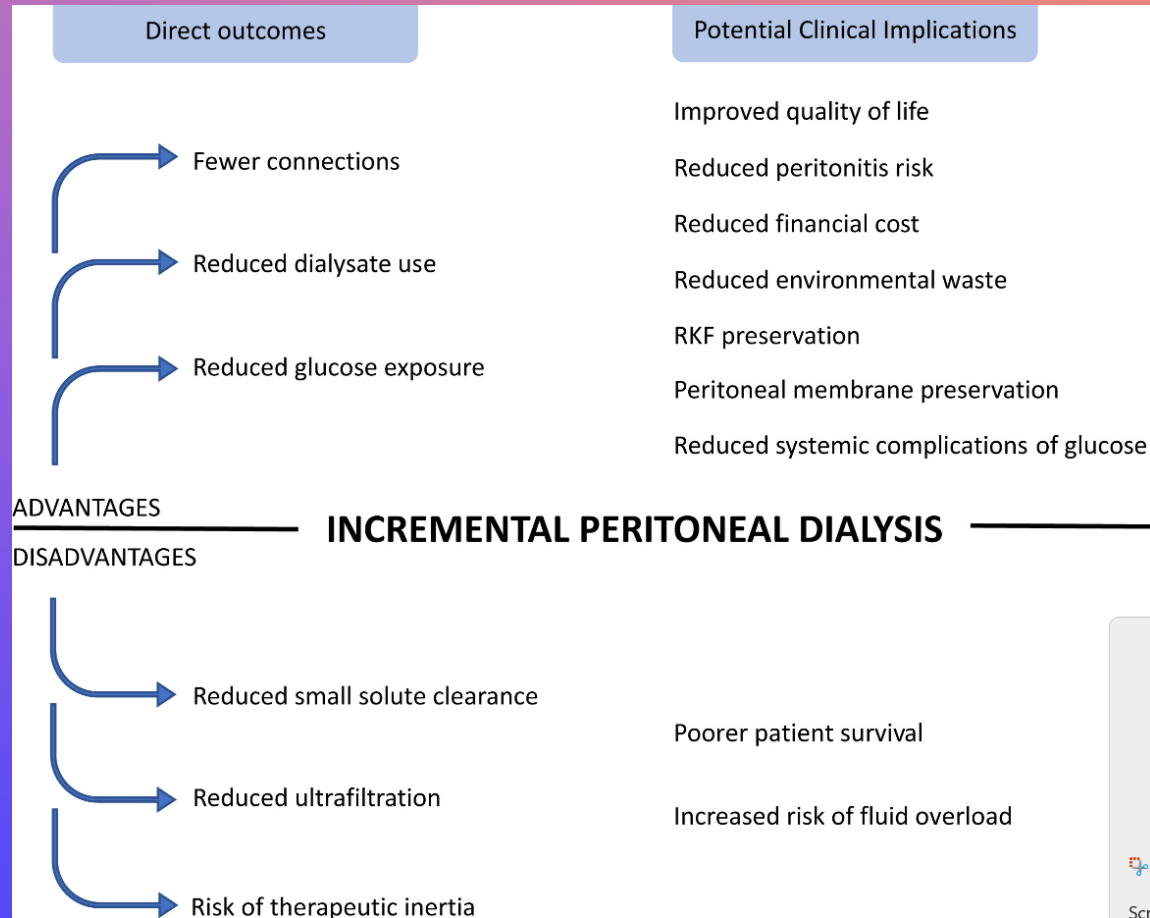
## Incremental PD: Advantages

- ↓ time / burden (Person Centered)
- ↓ cost
- ↓ glucose
- ↓ mechanical stress
- Possibly ↓ peritonitis

## Incremental PD: Take Away

- Viable option, Initial start patients / residual kidney function
- Multiple patient centered and potential physiologic benefits
- Requires serial measures of residual kidney function (at least q3 months)
  - **Maintain** = ACEi or ARB, Avoid volume depletion, Avoid toxic exposures
  - **Plan** = increase PD Rx as lost





# A multicenter feasibility randomized controlled trial to assess the impact of incremental versus conventional initiation of hemodialysis on residual kidney function



OPEN

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Twice-weekly hemodialysis, as part of incremental initiation, has reported benefits including preservation of residual kidney function (RKF). To explore this, we initiated a randomized controlled feasibility trial examining 55 incident hemodialysis patients with urea clearance of 3 ml/min/1.73 m<sup>2</sup> or more across four centers in the United Kingdom randomized to standard or incremental schedules for 12 months. Incremental hemodialysis involved twice-weekly sessions, upwardly adjusting hemodialysis dose as RKF was lost, maintaining total (Dialysis + Renal) Std Kt/V above 2. Standard hemodialysis was thrice weekly for 3.5–4 hours, minimum Dialysis Std Kt/V of 2. Primary outcomes were feasibility parameters and effect size of group differences in rate of loss of RKF at six months. Health care cost impact and patient-reported outcomes were explored. Around one-third of patients met eligibility criteria. Half agreed to randomization; 26 received standard hemodialysis and 29 incremental. At 12 months, 21 incremental patients remained in the study vs 12 in the standard arm with no group differences in the urea clearance slope. Ninety-two percent of incremental and 75% of standard arm patients had a urea clearance of 2 ml/min/1.73 m<sup>2</sup> or more at six months. Serious adverse events were less frequent in incremental patients (Incidence Rate Ratio 0.47, confidence interval 0.27–0.81). Serum bicarbonate was significantly lower in incremental patients indicating supplementation may be required. There were three deaths in each arm. Blood pressure, extracellular fluid and patient-reported outcomes were similar. There was no signal of benefit of incremental hemodialysis in terms of protection of RKF or Quality of Life score. Median incremental hemodialysis costs were significantly lower

compared to standard hemodialysis. Thus, incremental hemodialysis appears safe and cost-saving in incident patients with adequate RKF, justifying a definitive trial.

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KEYWORDS: adequacy; hemodialysis; incremental; residual kidney function; solute; urea

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Incremental dialysis is a method of prescribing dialysis whereby as residual kidney function (RKF) reduces, the amount of dialysis delivered is progressively increased. This is commonly performed in peritoneal dialysis<sup>1</sup> but is unusual in hemodialysis (HD). Safe performance of incremental dialysis requires frequent measurement of RKF and adjustment of dialysis prescription. The concept is to combine clearance by dialysis and RKF into a composite measure and ensure that this total clearance remains above accepted minimum levels. Incremental HD often involves initiating treatment twice-weekly dialysis and increasing sessional time and frequency as required. Initiation may thus be smoother. With standard approaches to hemodialysis initiation, excess mortality has been reported in the initial months of treatment, perhaps related to associated physical and psychological stresses.<sup>2,3</sup> Evidence for the safety and effectiveness of incremental HD is limited to observational data,<sup>4–6</sup> though a role is recognized in clinical practice guidelines.<sup>7</sup>

Retention of RKF is a strong predictor of survival in both HD and peritoneal dialysis. Improved fluid, blood pressure,



## PRESENTATION TITLE

Questionnaire	Study arm	Time point			Between-arm comparison, P <sup>a</sup>
		Baseline	6 mo	12 mo	
CFS	Standard	2.9 ± 1.3	3.1 ± 1.4	3.0 ± 1.4	0.18
	Incremental	2.9 ± 1.2	3.0 ± 1.0	2.7 ± 1.0	
IIRS	Standard	32.2 ± 11.8	35.5 ± 12.4	33.8 ± 12.9	0.50
	Incremental	33.8 ± 16.2	33.0 ± 15.3	33.0 ± 15.3	
MoCA	Standard	26.0 (IQR, 25.0–27.8)	26.5 (IQR, 25.0–27.0)	26.5 (IQR, 23.5–29.25)	0.87
	Incremental	28.0 (IQR, 26.25–29.0)	27.0 (IQR, 26.0–28.0)	27.0 (IQR, 25.25–28.0)	
PHQ9	Standard	3.0 (IQR, 0.5–12.25)	5.0 (IQR, 1.25–7.75)	4.5 (IQR, 2.5–13.5)	0.96
	Incremental	2.0 (IQR, 1.0–4.5)	2.0 (IQR, 0.5–4.0)	2.0 (IQR, 1.0–4.0)	

CFS, Clinical Frailty Scale; IIRS, Illness Intrusiveness Rating Scale; IQR, interquartile range; MoCA, Montreal Cognitive Assessment; PHQ9, Patient Health Questionnaire 9.

## Rationale and Strategies for Preserving Residual Kidney Function in Dialysis Patients

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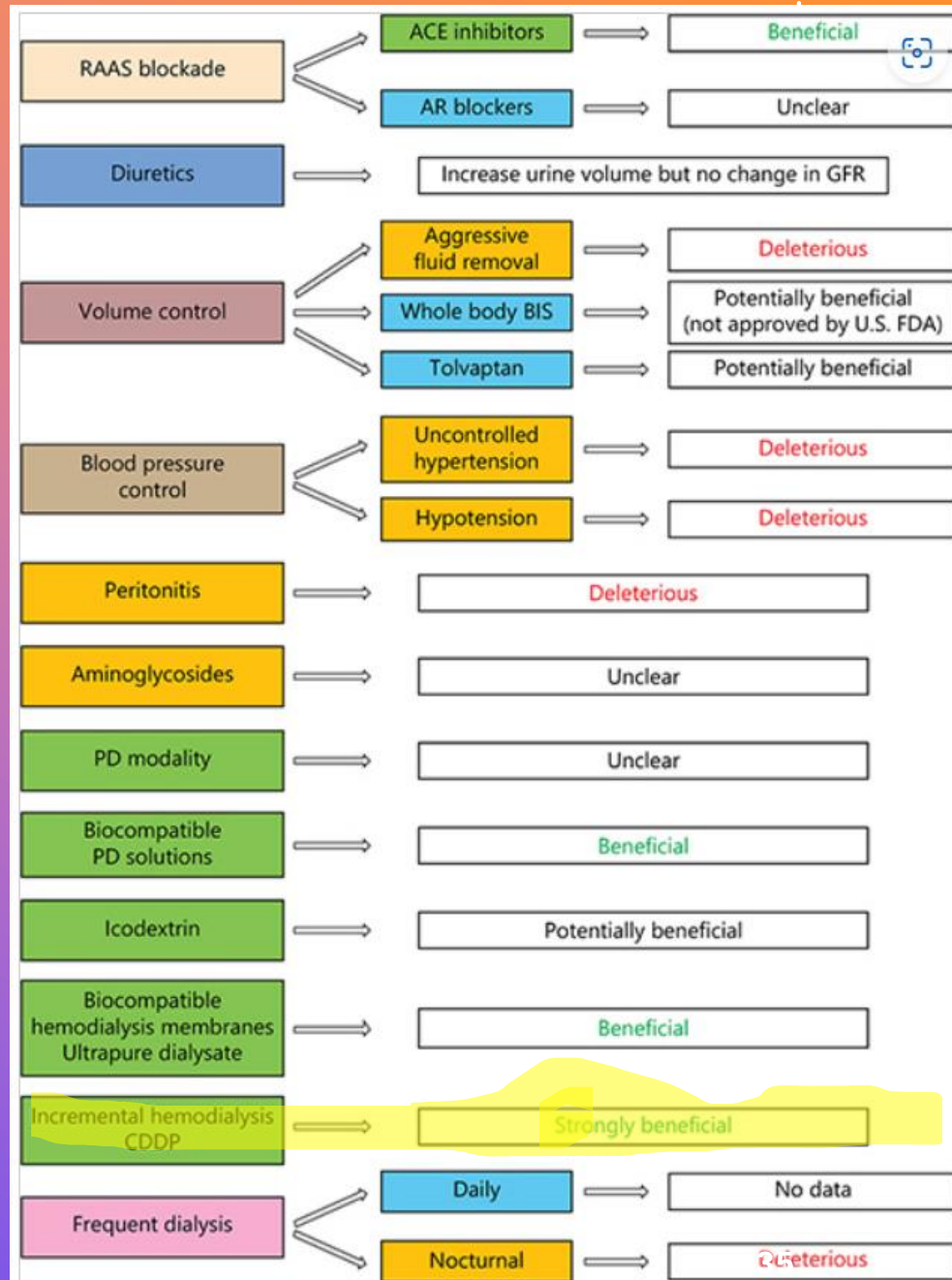
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### Incremental (twice-weekly) HD treatment criteria [69]

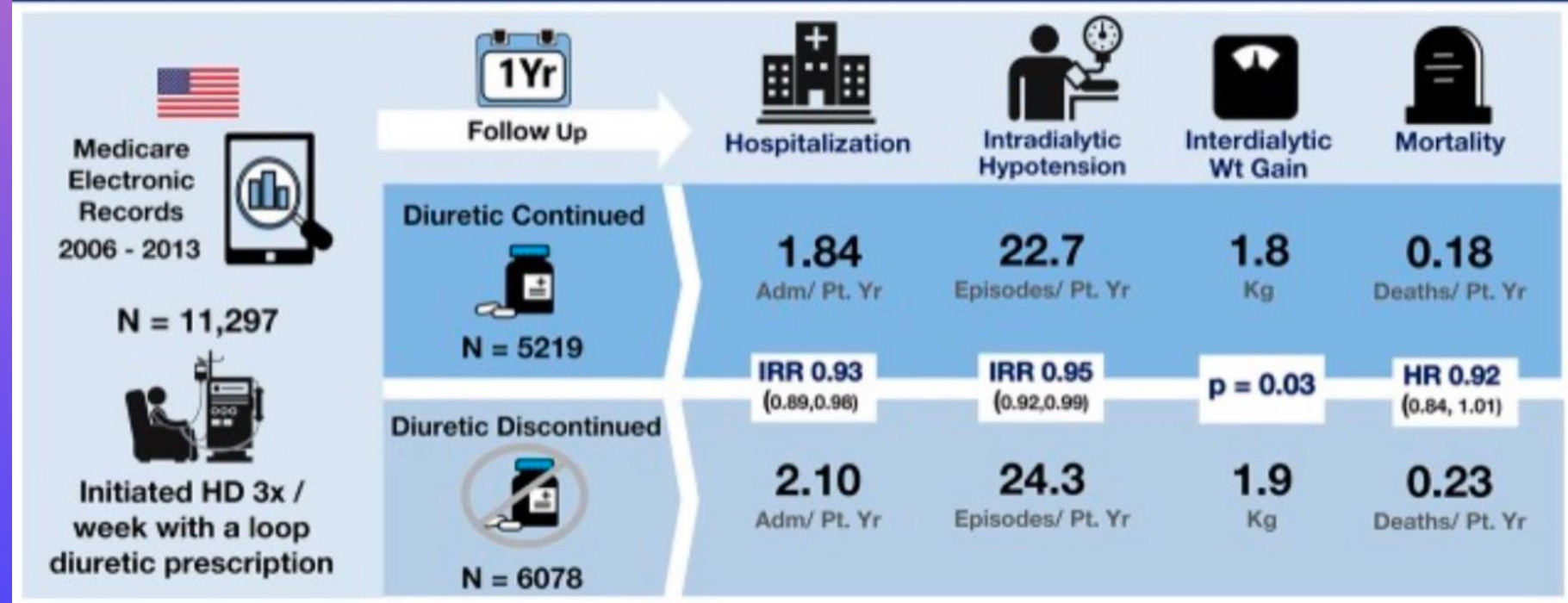
1. Adequate residual kidney function with urine output >600 mL/day (transition to thrice-weekly if urine output drops to <500 mL/day)
2. Limited fluid retention between 2 consecutive HD treatments with a fluid gain <2.5 kg (or <5% of the ideal dry weight) without HD for 3–4 days
3. Limited or readily manageable cardiovascular or pulmonary symptoms without clinically significant fluid overload
4. Suitable body size relative to residual renal function; patients with larger body size may be suitable for twice-weekly HD if not hypercatabolic
5. Hyperkalemia (K >5.5 mEq/L) infrequent or readily manageable
6. Hyperphosphatemia (P > 5.5 mg/dL) infrequent or readily manageable
7. Good nutritional status without florid hypercatabolic state
8. Lack of profound anemia (hemoglobin >8 g/dL) and appropriate responsiveness to anemia therapy
9. Infrequent hospitalization and easily manageable comorbid conditions
10. Satisfactory health-related quality of life and functional status
11. KRU >3 mL/min/1.73 m<sup>2</sup> (transition to thrice-weekly if KRU <2 mL/min/1.73 m<sup>2</sup>)

HD, hemodialysis; K, serum potassium; P, serum phosphorus; KRU, residual urea clearance.





# Can continuing loop diuretics improve clinical outcomes in HD?



**Conclusions** Continuation of loop diuretics is associated with lower rates of hospitalization, intradialytic hypotension and lower interdialytic weight gain, but no difference in mortality over first year of HD initiation.

Scott Sibbel, Adam Walker, Carey Colson, Francesca Tentori, Steven Brunelli, Jennifer Flythe. **Association of Continuation of Loop Diuretics at Hemodialysis Initiation with Clinical Outcomes.** CJASN doi: 10.2215/CJN.05080418. Visual Abstract by Divya Bajpai, MD



RESEARCH

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# Can residual kidney function affect quality of life and cognitive function in hemodialysis patients?

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## Abstract

**Background:** Residual kidney function (RKF) may provide many benefits to patients on permanent renal replacement therapy that are reflected in better control of biochemical parameters. In hemodialysis patients, quality of life (QOL) and cognitive function are often impaired. This study aimed to assess the predictors of RKF and its impact on QOL and cognitive function in chronic hemodialysis patients.

**Patients and methods:** The study involved seventy-eight patients suffering from end-stage renal disease on regular hemodialysis. The patients were divided into two groups according to the presence or absence of RKF (24-hour urine volume  $\geq 100$  ml). Beside basic laboratory investigations, all patients were subjected to Kidney Disease Quality of Life-Short Form (KDQOL-SF) version 1.3 for assessing the quality of life and Montreal cognitive assessment (MoCA) score for assessing cognitive function.

**Results:** There was a significantly higher score for KDQOL domains and MoCA score in patients with RKF compared to patients without RKF. There was a significant positive correlation between RKF and both of MoCA score and the physical composite score (PCS) of QOL. Moreover, there were statistically significant positive correlations between the MoCA score and both PCS and mental composite score (MCS). On multivariate analysis, hemodialysis duration was the only predictor for RKF; whereas age was a significant predictor for PCS; and MoCA score could be significantly predicted by the measured RKF and patients' age.

**Conclusion:** HD patients with maintained RKF had better QOL and cognitive function. The duration of HD and the age of the patients were found to be related to RKF and PCS in this study. RKF was associated with the cognitive performance of hemodialysis patients.

**Keywords:** Chronic kidney disease, Hemodialysis, Residual kidney function, Quality of life, Cognitive function

**Table 4** MoCA domains according to RKF status

MoCA domains	Max points of test	Group A (RKF) (n = 29)	Group B (No RKF) (n = 49)	P
Level of education (< 12 years)		23 (79.3%)	29 (57.1%)	<b>0.047</b>
Visuospatial executive	5	4 (3–5)	3 (1–4)	<b>0.002</b>
Naming	3	3 (3–3)	3 (3–3)	0.346
Attention	6	5 (4.50–5)	4 (4–5)	<b>0.004</b>
Language	3	3 (2–3)	2 (2–3)	<b>0.037</b>
Abstraction	2	2 (1.50–2)	2 (1–2)	0.237
Delayed recall	5	4 (3–4)	3 (3–4)	<b>0.001</b>
Orientation	6	6 (6–6)	6 (6–6)	0.407
<b>The total score of MoCA</b>	<b>30</b>	<b>27 (26–28)</b>	<b>24 (19.5–26)</b>	<b>&lt;0.001</b>

Abbreviation: MoCA Montreal Cognitive Assessment

## Prevalence and patterns of cognitive impairment in adult hemodialysis patients: the COGNITIVE-HD study

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PRESENTATION TITLE

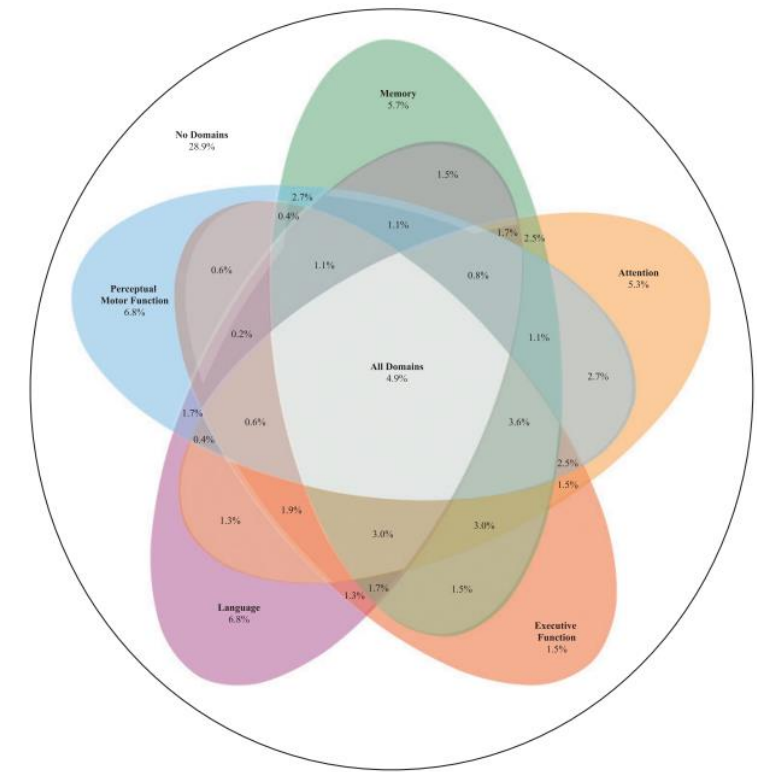


FIGURE 3: Patterns of impairment co-occurrence across all cognitive domains (N = 474). Values are the proportion of participants with each possible mutually exclusive combination of domain-specific impairment, from no domains (white circle outside the Venn diagram) to all five domains (center of the Venn diagram).

# Are Nephrologists prepared for Neuro-Nephrology?

Clinical skills	Therapeutics	Imaging
<i>Screening tests:</i> <ul style="list-style-type: none"><li>• Mini Mental State Examination (MMSE)</li><li>• Montreal Cognitive Assessment (MoCA)</li></ul>	<ul style="list-style-type: none"><li>• Memantine (Glutamate antagonist)</li><li>• Donepezil (increases acetylcholine)</li></ul>	<ul style="list-style-type: none"><li>• fMRI</li><li>• Brain tractography</li></ul>

# And Neurologists?

Clinical skills	Therapeutics	Diagnostics
<ul style="list-style-type: none"><li>• <i>eGFR</i></li><li>• <i>Proteinuria,, ACR</i></li></ul>	<ul style="list-style-type: none"><li>• New Dialysis types</li></ul>	<ul style="list-style-type: none"><li>• Uremic toxins</li></ul>



## Benefits of Residual Kidney Function in ESRD

- Fluid removal<sup>1</sup>
- Sodium removal<sup>1</sup>
- Phosphate removal<sup>1,2</sup>
- Middle molecule clearance<sup>1,2</sup>
- Vitamin D production<sup>2</sup>
- Erythropoietin production<sup>1</sup>
- Reduced Left ventricular hypertrophy<sup>1,2</sup>
- Survival benefit<sup>1</sup>

<sup>1</sup>Wang AYM, Lai KN. The importance of residual renal function in dialysis patients. *Kidney Int*. 2006;69:1726-1732.



# What incremental dialysis is not

- Incremental PD is **not** the prescription of less than standard full-dose PD because of *financial constraints* or because a person is on a *palliative trajectory* or because clearance goals or targets are not considered important.
- It does **not** remove the need for measuring peritoneal and renal clearances as these remain key pieces of information supporting the setting and attainment of shared treatment goals
- It is **not early** start (not advocated since IDEAL)

**Level of evidence—not applicable as this is a proposed definition**



## Residual Renal Function (RRF)

RRF declines more rapidly in patients on HD than PD therapy.

- Shafi et al, CHOICE Study (AJKD 2010):  
617 of 734 (**84%**) HD patients reported good urine output at baseline, but only **28%** had acceptable RRF after 1 year.
- Preserved RRF was associated with **lower mortality** (hazard ratio, **0.70**, CI: 0.52-0.93) and **better Quality of Life**, lower CRP ( $P = 0.02$ ) and interleukin 6 ( $P = 0.03$ ) levels, and 12,000-U/wk lower erythropoietin doses ( $P < 0.001$ ).<sup>15</sup>

Shafi, T., Jaar, B.G., Plantinga, L.C. et al. Association of residual urine output with mortality, quality of life, and inflammation in incident hemodialysis patients: the Choices for Healthy Outcomes in Caring for End-Stage Renal Disease (CHOICE) Study. Am J Kidney Dis. 2010; 56: 348-358

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ON TITLE

**Table 1.** Prevalence of depression among renal dialysis patients, employing screening or diagnostic schemes

Study	Measure/cut-off	Population	Prevalence %	95% confidence interval, %	n
Lowry and Atcherson [27]	American Psychiatric Association criteria	Initiating home HD	18	11.1–27.8	83
Smith et al. [28]	BDI Multiple Affect Adjective Check List DSM-III	HD, PD	47	34.7–59.7	60
			17	9.4–28.7	
			5	1.7–13.9	
Wuerth et al. [29]	BDI ≥11	PD	49	44–54	380
Wilson et al. [30]	BDI ≥14 Nurse Nephrology team	HD	38.7	30.5–47.6	124
			41.9	33.5–50.8	
			24.2	17.5–32.5	
Sacks et al. [20]	BDI ≥16	HD, PD	26	16.2–38.9	57
Kimmel [1]	BDI >15 BDI >10	HD	24.7	20.1–29.9	300
			46.4	40.8–52.1	
Lopes et al. [31]	CES-D ≥10 Physician diagnosed	HD	43.0	41.8–44.2	6,987
			13.9	13.1–14.7	
Craven et al. [19]	Diagnostic Interview Schedule III	HD, PD	8.1	4.1–15.3	99
Martin et al. [32]	HADS ≥8	HD	71.4	52.1–85.2	28
		PD	25	16.3–36.3	72
Boulware et al. [33]	MHI-5 ≤52 (baseline) MHI-5 ≤52 (over time)	HD, PD	19	16.6–21.7	917
			24	21.3–26.9	
Lopes et al. [34]	Physician diagnosed 'Down hearted and blue question' <sup>1</sup> 'So down in the dumps ...' <sup>1</sup>	HD	17.7	16.5–18.6	5,256
			21.5	20.4–22.7	4,881
			19.5	18.4–20.6	4,901
Drayer et al. [22]	Primary Care Evaluation of Mental Disorders	HD	28	18.2–40.5	62
Hinrichsen et al. [35]	Research diagnostic criteria – minor/major depressive disorder	HD	17.7 6.5	11.9–25.4 3.3–12.3	124
Hedayati et al. [36]	Structured Clinical Interview DSM-IV	HD	26.5	18.7–36.1	98
Kalender et al. [37]	Structured Clinical Interview DSM-IV	HD	33.8	23.5–45.9	68
		PD	12.8	5.9–25.6	47
Watnick et al. [10]	Structured Clinical Interview DSM-IV	HD, PD	19	11.0–30.7	62

MHI-5 = Subscale of Medical Outcomes Study Short Form 36; CES-D = Centre for Epidemiological Studies Depression Screening Index.

<sup>1</sup> Unconventional approach – questions taken from the Kidney Disease and Quality of Life Short Form.

Minireview

**Clinical Practice**

Nephron Clin Pract 2008;108:c256–c264  
DOI: 10.1159/000124749

Published online: April 10, 2008

**Depression on Dialysis**

Joseph Chilcot<sup>a,b</sup> David Wellsted<sup>b</sup> Maria Da Silva-Gane<sup>a</sup> Ken Farrington<sup>a,b</sup>

Editorial > Perit Dial Int. 2023 Sep;43(5):355-358. doi: 10.1177/08968608231195464.

## Incremental peritoneal dialysis: Incremental gains

Arti Dhoot <sup>1</sup>, Edwina A Brown <sup>2</sup>, Bruce Robinson <sup>3</sup>, Jeffrey Perl <sup>1</sup>

Affiliations + expand

PMID: 37674305 DOI: 10.1177/08968608231195464



'One size fits all'  
target driven  
approach to  
treatment – e.g.  
 $Kt/V=1.7$



'Goal directed'  
therapy in which the  
dialysis dose is  
titrated in an attempt  
to achieve an agreed  
objective

PRESENTATION TITLE

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# THANK YOU

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