Advantages of home dialysis

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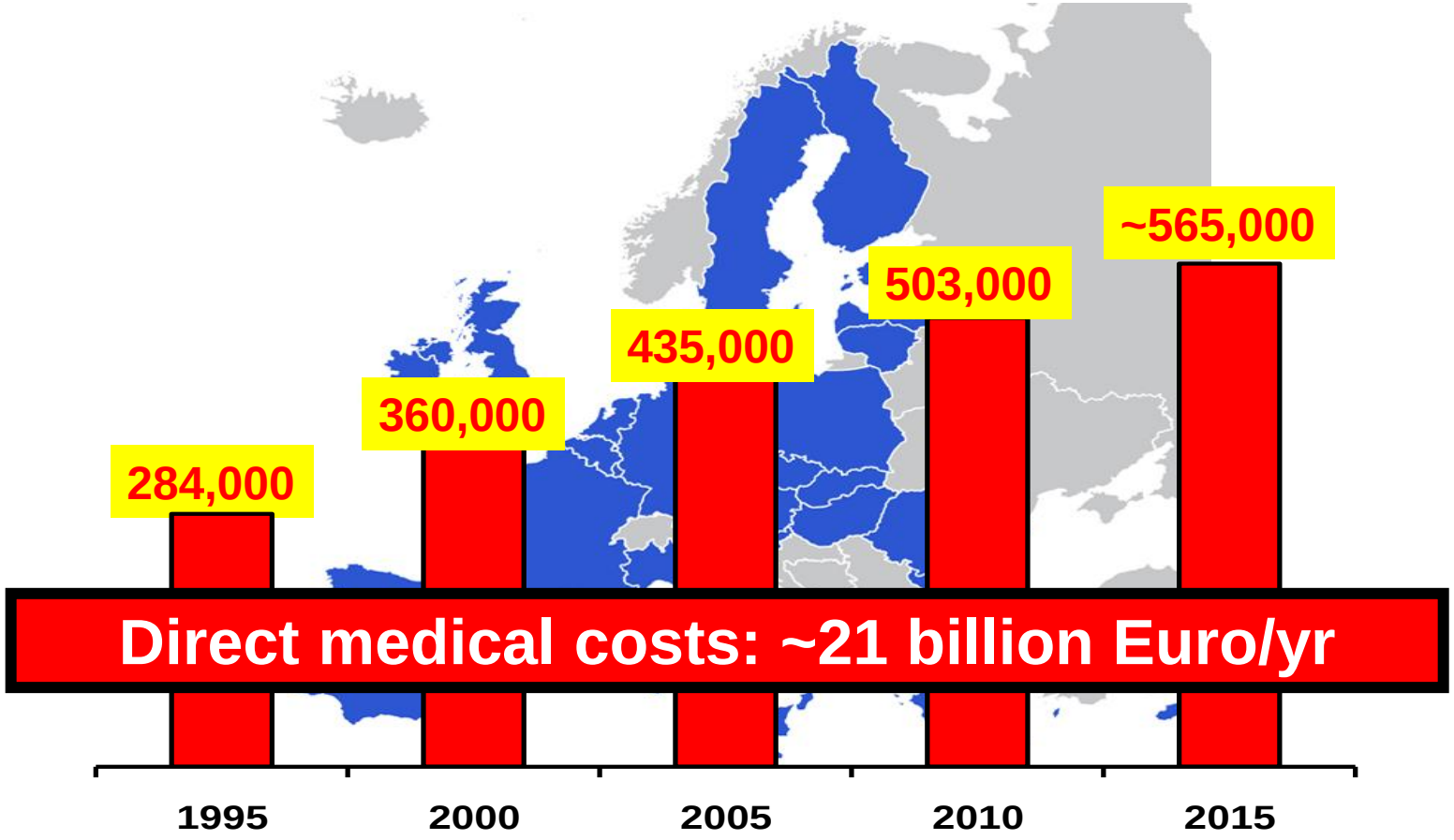
Nr. of patients on Renal Replacement Therapy



Calculated for the EU-27 countries

ERA-EDTA Registry

Health care costs for different chronic diseases in Spain-costs RRT UK

Disease	No. of patients	% affected people per total population	% total NHS budget	Annual average cost per patient (€)	Source
Renal replacement therapy	45 000	0.1%	2.50%	47 000 € (HD)	BAP RRT Economic
UK	**47525**	**0.05%**	**1-2%**	32 000 € (DP)	Evaluation
Asthma	4500 000	9.70%	5%	1950 €	ASMACOST
HIV	100 000	0.2%	0.40%	5400-7500 €	Spanish Health Ministry
COPD	1500 000	3.25%	2%	1876 €	SEPAR

Arrieta et al, Nefrologia 2011;31(5):505-513

UK data Sharif, Baboolal, PDI,2011; 31(S2):S58–S62

Country/region providing individual patient data	2005 (p.m.p.)	2006 (p.m.p.)	2007 (p.m.p.)	2008 (p.m.p.)	2009 (p.m.p.)
All countries	130.8	131.7	129.5	129.1	127.0
Belgium					
Dutch speaking	172.8	178.5	174.3	173.5	181.3
French speaking	180.6	190.9	190.5	194.0	198.7
Denmark	124.1	122.5	147.9	125.3	126.0
Finland	96.2	86.0	90.2	92.3	79.7
Greece	181.8	182.4	174.5	181.4	182.4
Iceland	85.2	83.9	94.2	89.1	111.5
Italy (Calabria)	135.9	133.4	145.5	151.2	138.4
Norway	105.9	106.7	119.6	119.4	121.6
Spain					
Andalusia	146.2	143.7	131.4	135.9	128.6
Asturias	104.9	112.1	108.7	109.3	112.1
Basque country	112.5	103.2	104.9	100.5	117.5
Cantabria	151.0	118.0	99.7	103.3	102.3
Castille and Leon	99.2	104.5	104.2	108.5	96.3
Castille-La Mancha	121.4	107.1	98.5	98.3	93.1
Catalonia	149.5	133.6	142.3	140.7	142.3
Extremadura	116.4	127.7	97.8	127.2	100.4
Valencian region	147.5	153.1	147.1	136.3	139.3
Sweden	116.1	124.0	122.6	116.9	119.3
The Netherlands	115.5	119.9	122.9	128.5	125.3
UK, all countries	115.3	116.8	112.7	111.6	108.8
UK, England	111.5	115.0	110.7	111.9	109.5
UK, Northern Ireland	161.6	142.1	129.6	123.0	100.6
UK, Scotland	126.4	117.0	113.7	106.8	104.1
UK, Wales	128.0	131.6	136.2	111.0	110.6

Renal replacement therapy in Europe—a summary of the 2009 ERA–EDTA Registry Annual Report

Incidence of RRT p.m.p. at Day 1 period 2005-2009

van de Luijtgaarden et al, CKJ, 2012, 5: 109–119

Incidence of RRT count (pmp)and age distribution at Day 1 in 2010 -Belgium

Country/region providing individual patient data	All ages N	Mean age	20–44 years N (pmarp)	45–64 years N (pmarp)	65–74 years N (pmarp)	75+ years N (pmarp)
Belgium						
Dutch-speaking[a]	1226	69.8	92 (45.5)	288 (166.0)	292 (507.0)	554 (975.0)
French-speaking[a]	885	67.5	76 (48.1)	275 (229.4)	195 (560.5)	339 (893.5)

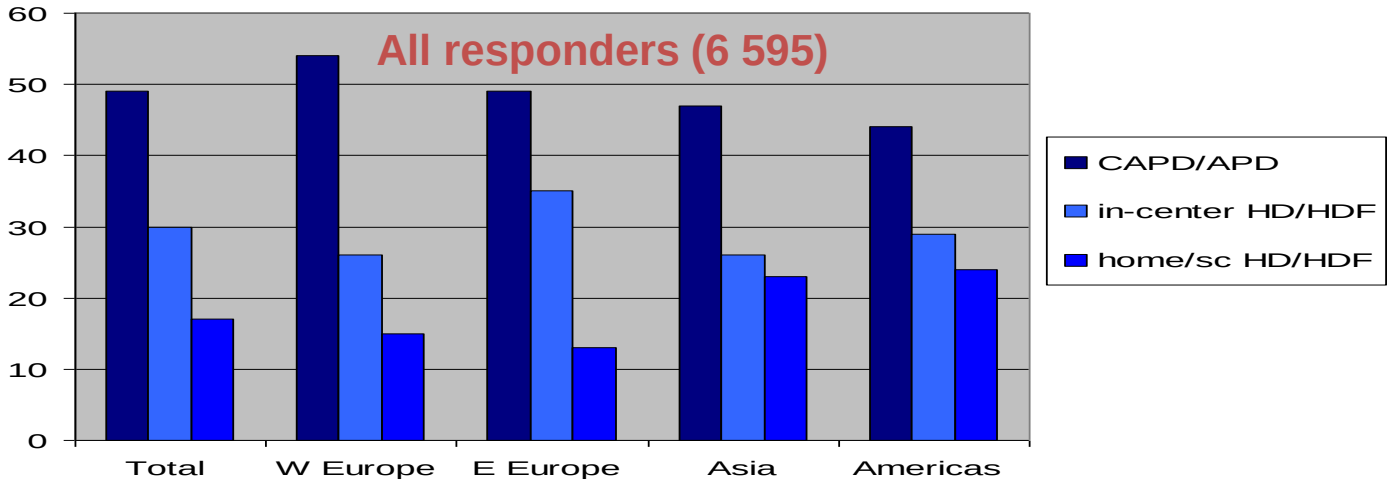
Prevalence of RRT/ pmp and distribution of treatment modality at 31 December 2010,

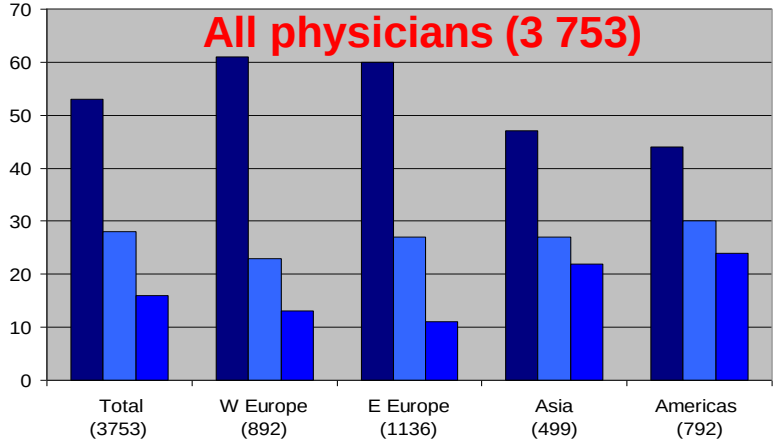
Country		HD N (pmp)	PD N (pmp)	Tx N (pmp)
	Total			
Belgium				
Dutch-speaking[a]	**7322**	3926 (625.2)	398 (63.4)	2998 (477.4)
French-speaking[a]	**5712**	3091 (669.6)	292 (63.3)	2329 (504.5)
	13034			

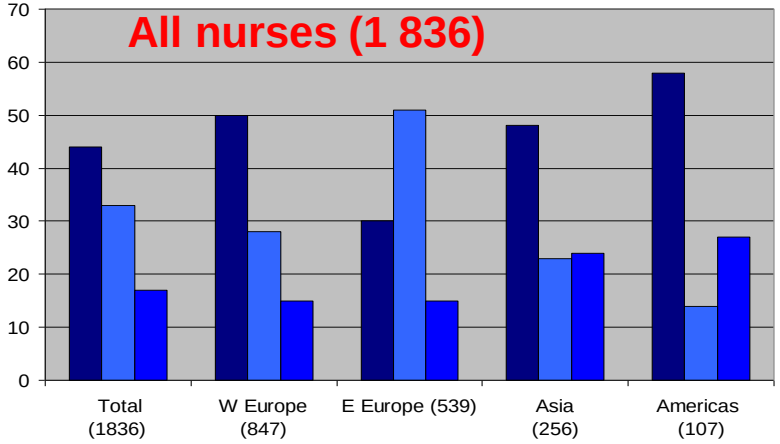
Therapeutic dialysis options

OPTION	LOCATION	MEANS	LABOR INTENSITY
Continuous Ambulatory Peritoneal Dialysis (CAPD)	Home	No machine	+
Automated Peritoneal Dialysis (APD)	Home	Machine	+
Home hemodialysis	Home	Machine	+
Self Care hemodialysis	Satellite or hospital	Machine	++
Hospital hemodialysis	Hospital	Machine	++++

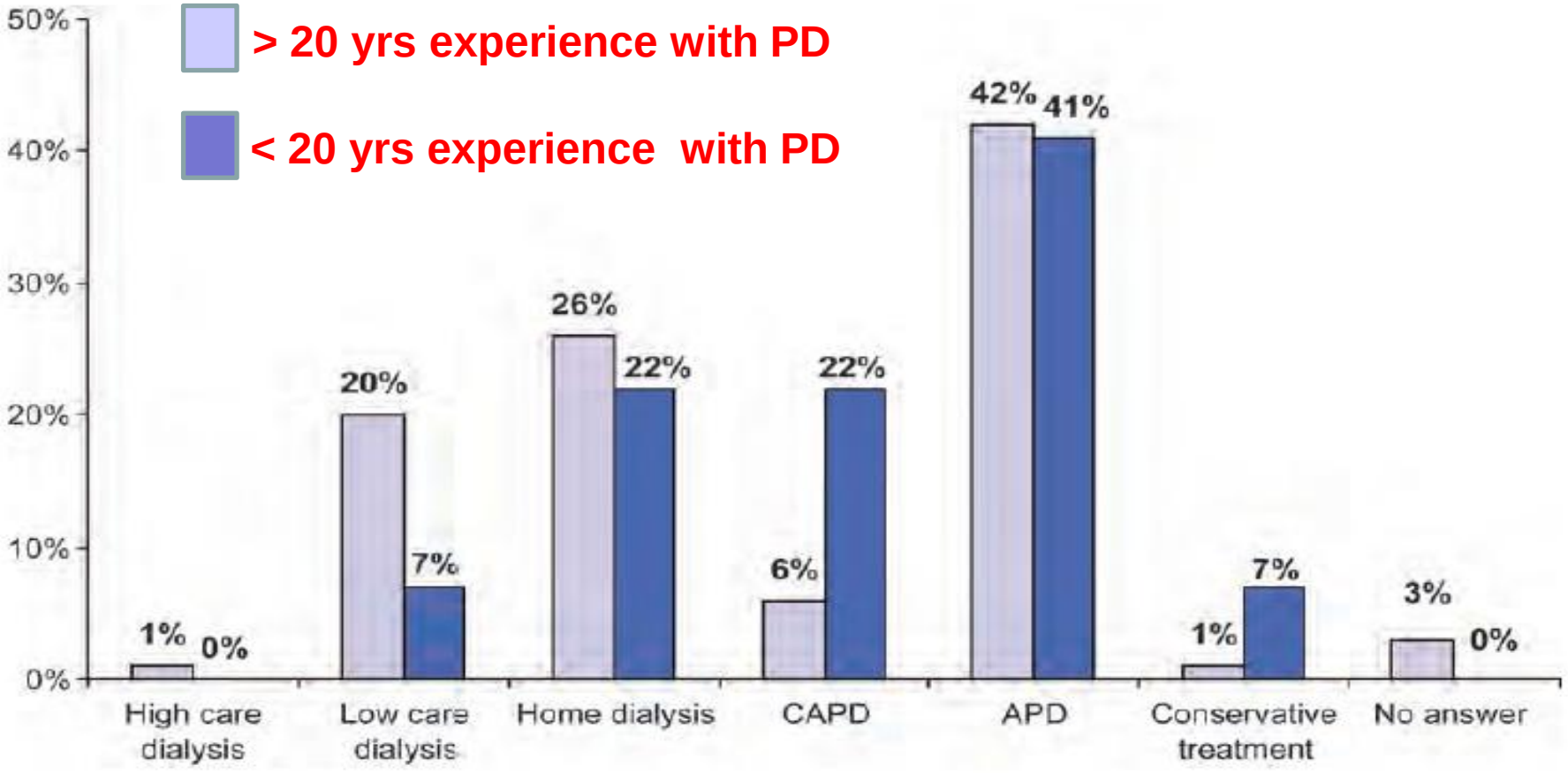
Best initial dialysis treatment







Nephrologists' first choice of RRT if they suffered from ESKD themselves (living donor excluded).



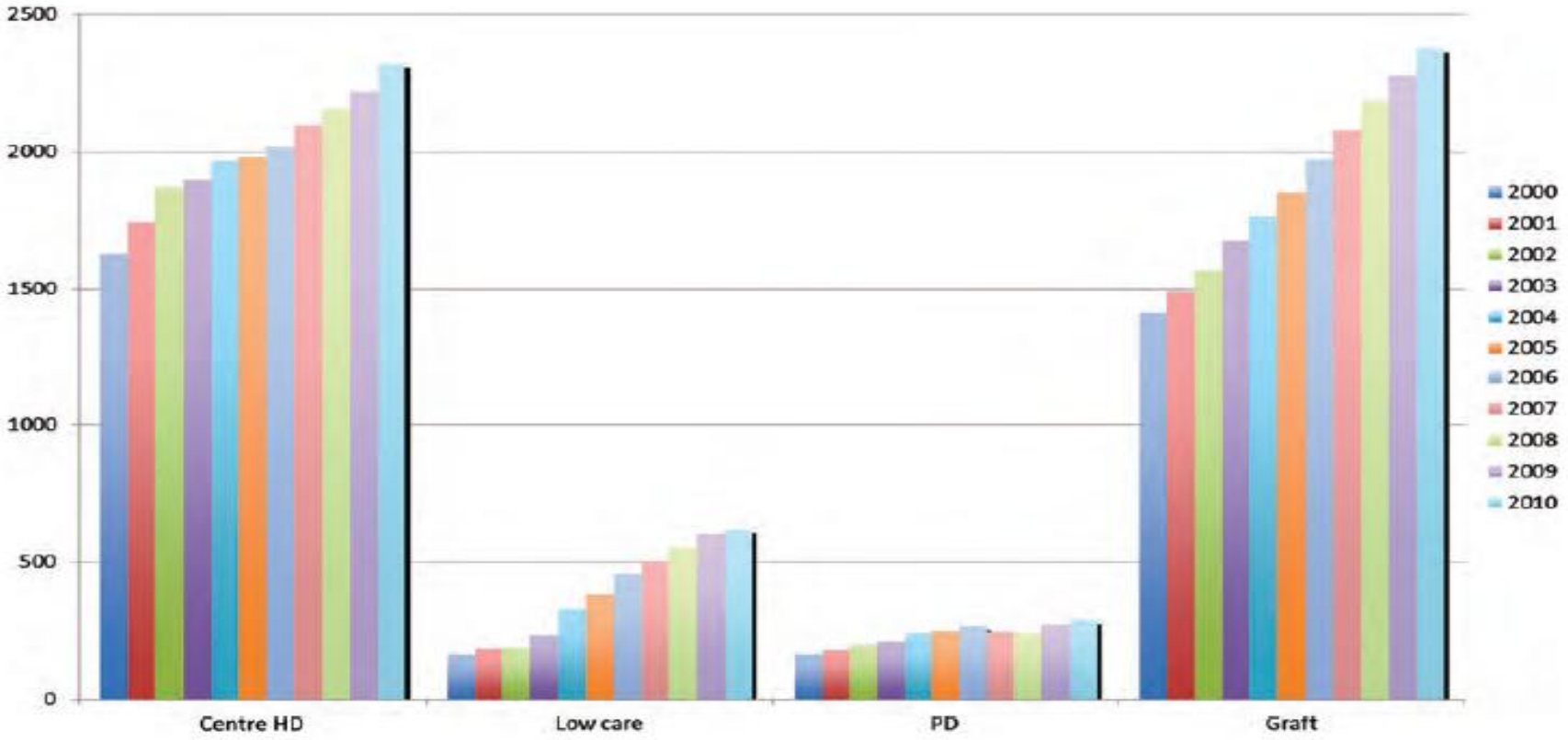
Desmet et al, Clin Kidney J (2013) 6: 358–362

Reasons for low usage of PD-opinion poll – French speaking Belgium

The medical contraindications	12
The important number of dialysis centres nearby	22
The ease of using HD as RRT	29
The lack of motivation of nephrologists (and GP's)	26
Fear of complications	6
Late referral	22
The need to use HD places with priority	4
The time needed to implement peritoneal dialysis	10
Lack of PD training (PD technique)	19
The need to have a nurse team dedicated to the technique	22
The need to have an experienced surgeon	4
Patient refusal (by choice)	28

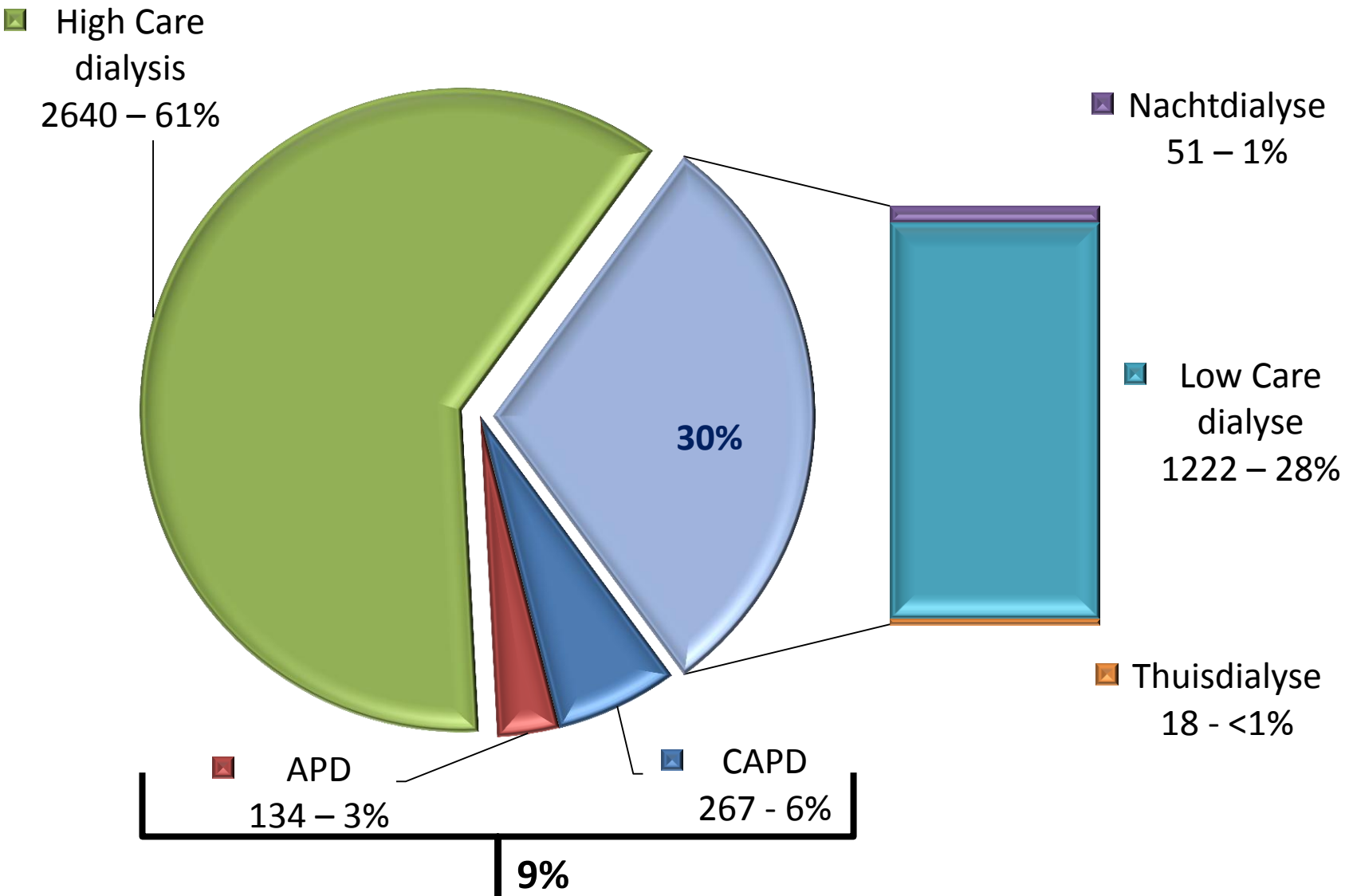
Desmet et al, Clin Kidney J (2013) 6: 358–362

Prevalent ESKD patients in the French-speaking part of Belgium. Patients are distributed according to the different RRT modalities from 2000-2010



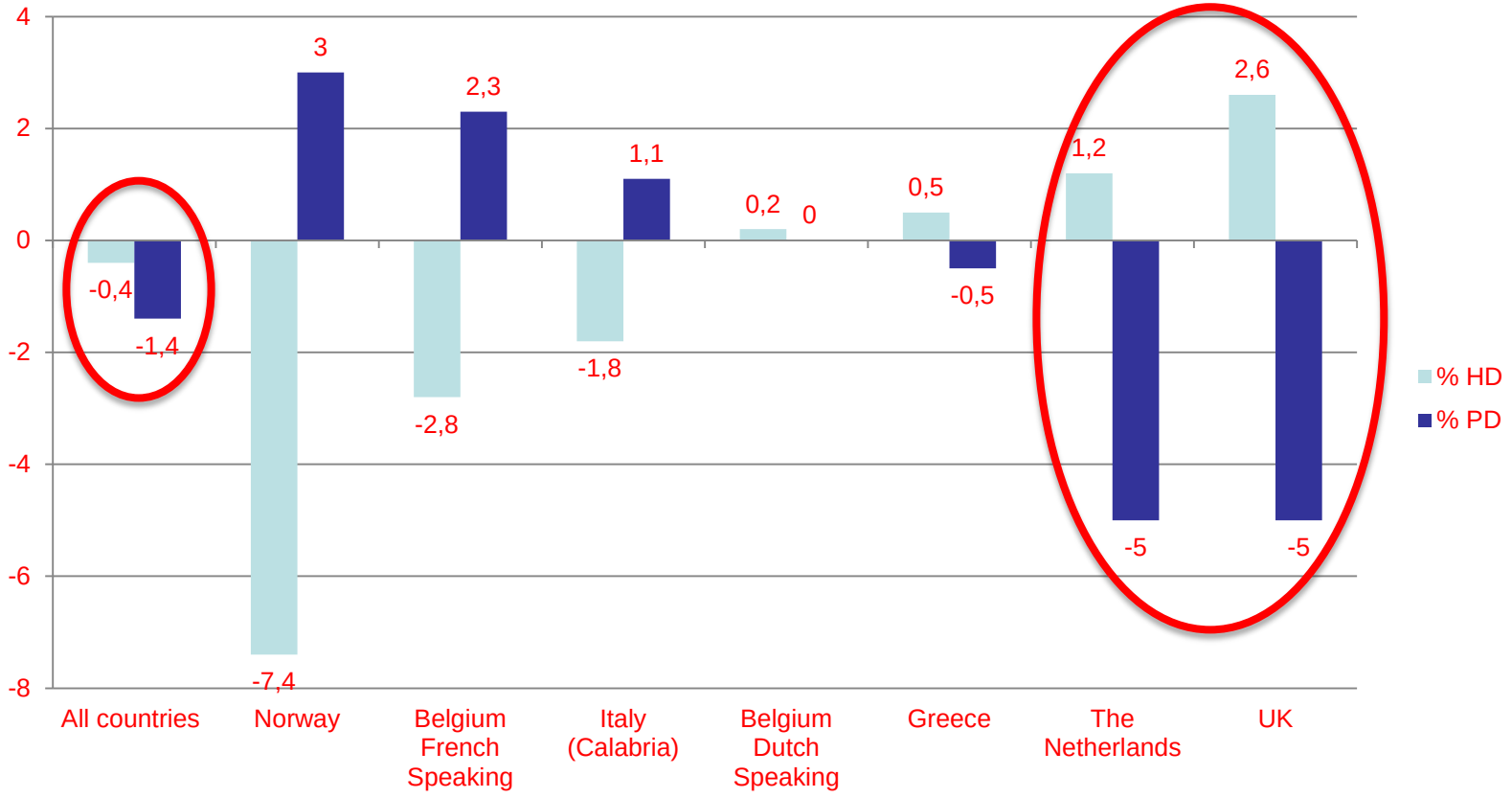
Desmet et al, Clin Kidney J (2013) 6: 358–362

Dialysis modality Belgium-Dutch speaking 2011



RRT in Europe—a summary of the 2009 ERA–EDTA Registry Annual Report-

Relative change in HD and PD Day 91 in 2009 compared to 2005

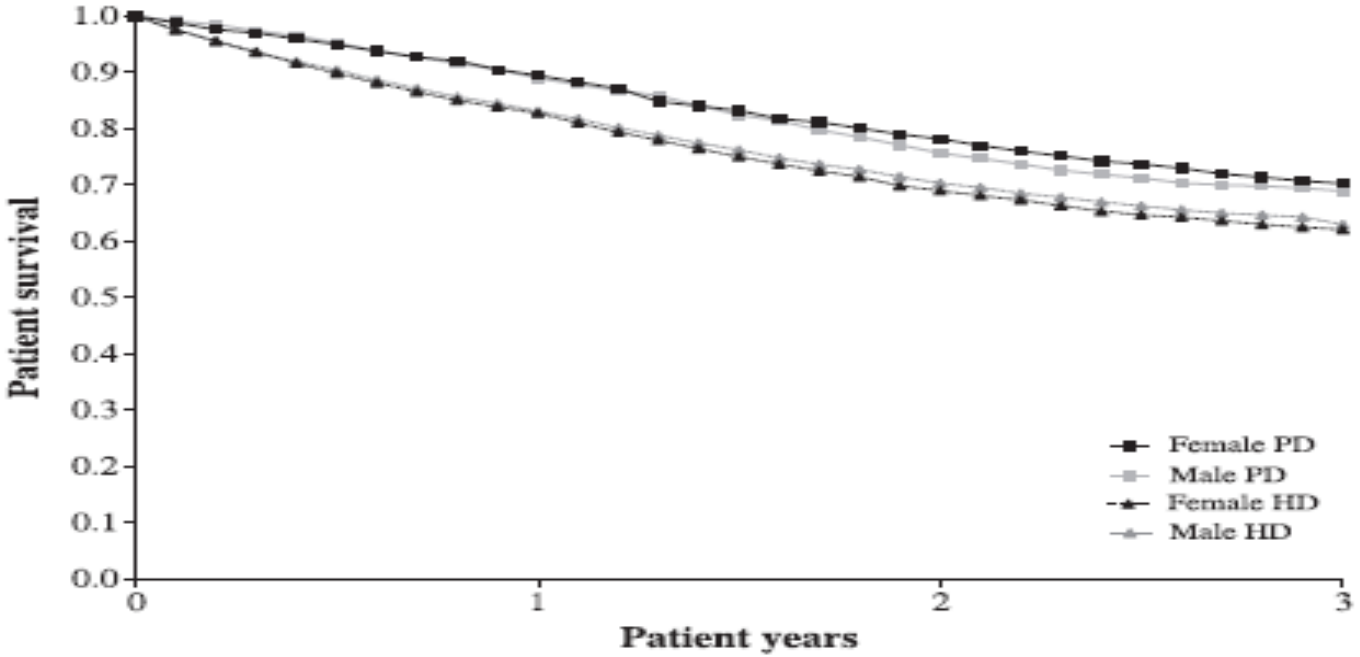


van de Luijtgaarden et al, Clin Kidney J (2012) 5: 109–119

Hypotheses to explain the decrease in use of PD

Hypotheses invoking medical causes
increasing age and comorbidity of ESRD population
concern about inferior outcomes with PD
belief about better outcomes with high-frequency hemodialysis
inability of inadequately trained nephrologists to prescribe complex regimens required to implement small solute clearance guidelines
Hypotheses invoking "system issues"/nonmedical causes
increasing density of hemodialysis units
corporatization of delivery of dialysis care, particularly in the United States
changing patterns for reimbursement for delivery of dialysis care

Crude survival of PD vs HD stratified for gender in selected EU countries



Number of patients at risk (n)

	0	1	2	3
Female PD	1108	784	488	228
Female HD	4645	3031	1886	1311
Male PD	1875	1293	810	403
Male HD	416	4892	3036	2006

Van de Luijtgaarden et al, NDT , 2011

Challenges in PD-reasons for its underutilisation

Modality related	Infections-peritonitis ,exit site, catheter Inadequate dialysis-targets UF problems
System-related	lack of infrastructure lack of patient modality education/training transfer to a facility where PD is unavailable centre effect provider expertise physician reimbursement ownership of dialysis facility
Patient related	Burnout ,social reasons, family, age, occupation, *etc.* geography: distance to travel loss of RRF malnutrition/excess protein loss diabetic complications: severe neuropathy, blindness abdominal surgeries or development of hernia respiratory problems, chronic cough stroke or severe illness limiting manual dexterity

Chaudhary et al, *Clin J Am Soc Nephrol 6: 447–456, 2011*

PD-advantages and challenges

Potential advantages

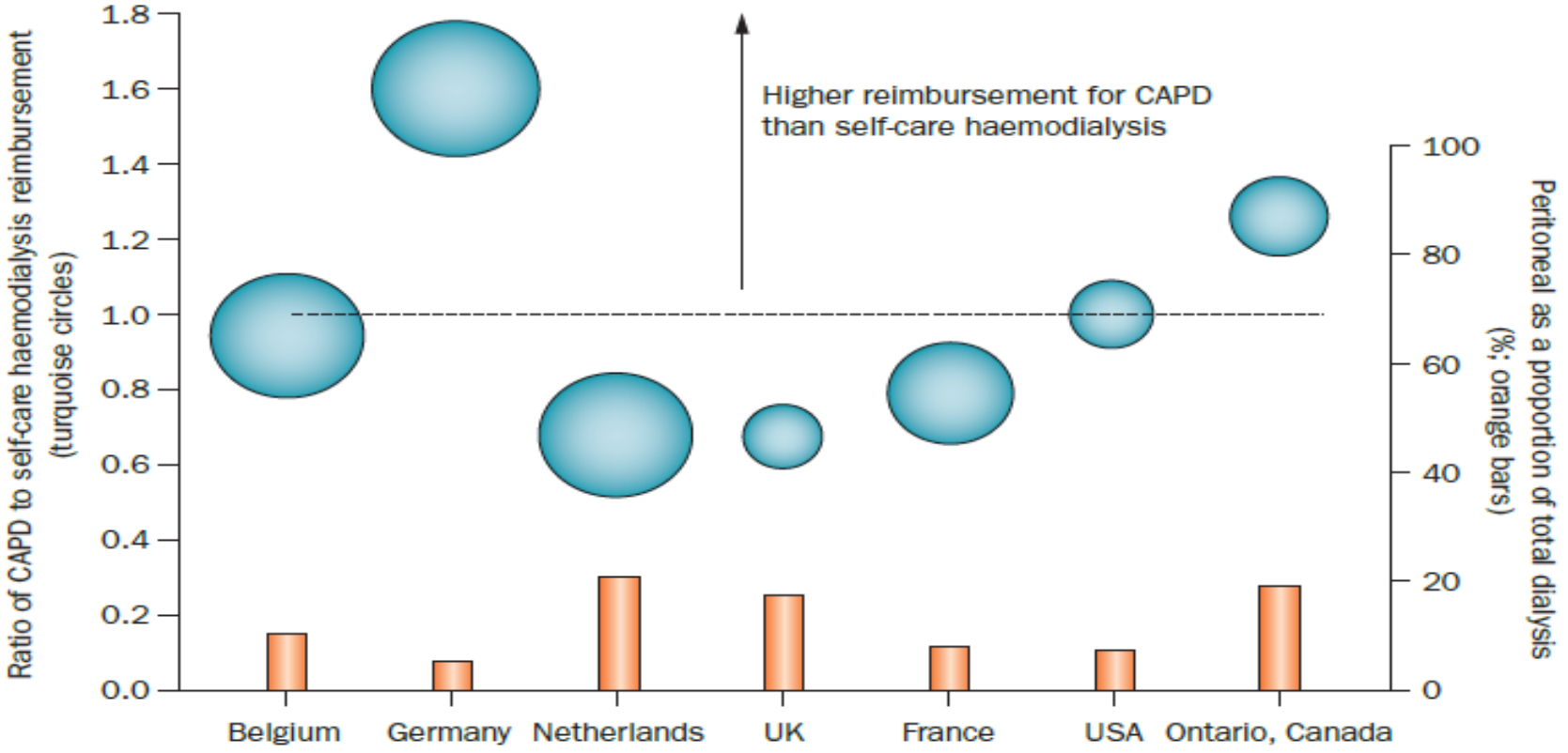
- Home therapy
- Less costly than haemodialysis in the majority of countries
- Promotes patient autonomy
- Less travelling for patients than with in-centre haemodialysis

Davies, S. J. ***Nat. Rev. Nephrol. 9, 399–408, 2013***

Strategies to improve PD

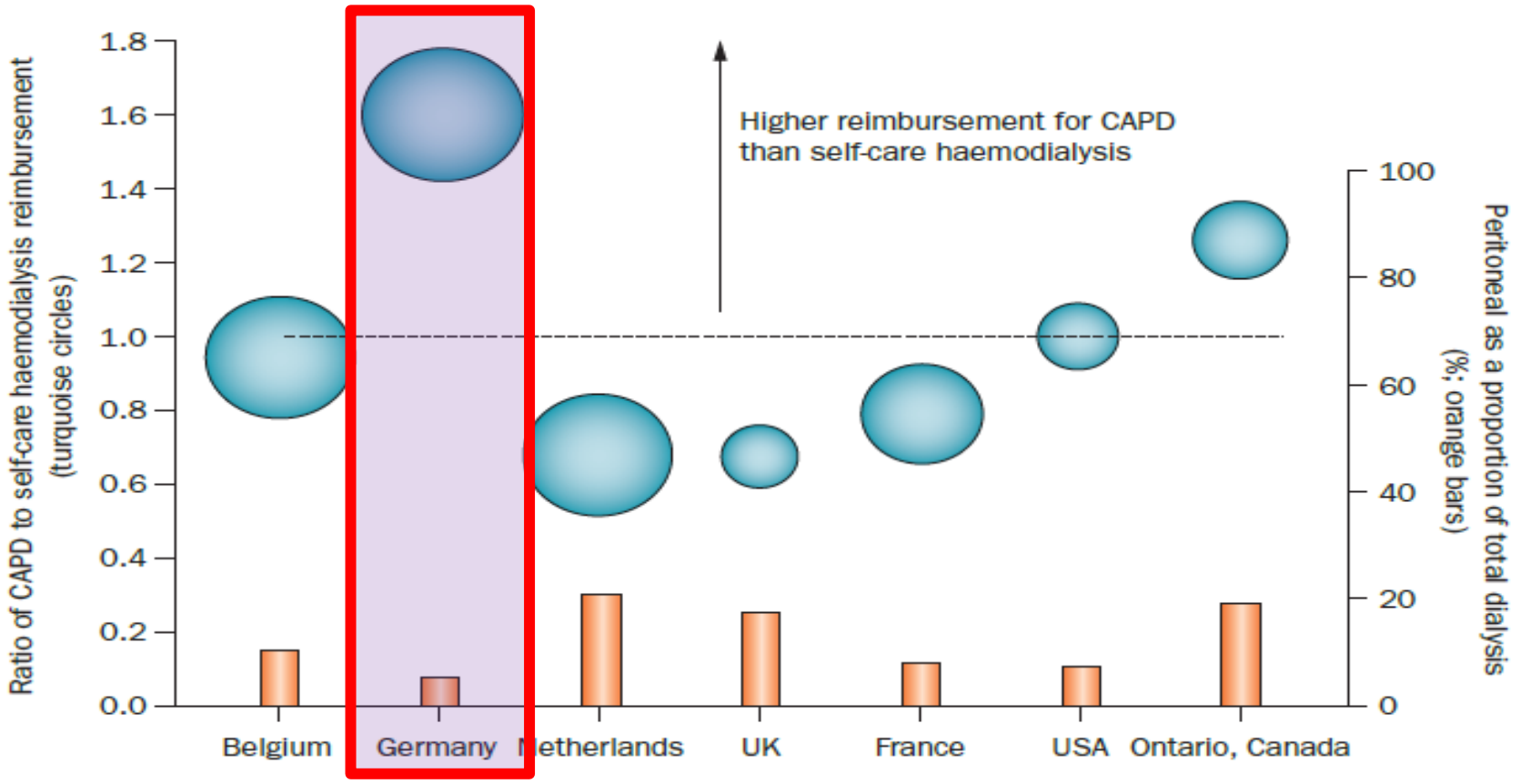
- **Provide adequate PD dialysis**
- **Preserve peritoneal membrane function**
  - reduce glucose exposure
  - use of more biocompatible solutions ??
- **Modify dialysis regime**
  - CAPD vs APD
  - continuous flow PD ???

Variation in reimbursement per week for self-care HD and CAPD services and correlations with the proportion of patients on PD



Chow, K. M. & Li, P. K.-T. *Nat. Rev. Nephrol. 8, 495–496 (2012)*

Variation in reimbursement per week for self-care HD and CAPD services and correlations with the proportion of patients on PD



Chow, K. M. & Li, P. K.-T. *Nat. Rev. Nephrol. 8, 495–496 (2012)*

What about home haemodialysis?

A way to increase dialysis frequency?

Why more frequent dialysis?

- Compared to three times weekly haemodialysis larger reductions in peak solute concentrations are achievable
- Increased frequency, and/or longer treatments allow improved control of extracellular volume
- Two different approaches:
  - Short daily haemodialysis, with 6 relatively short treatments per week (1.5-2.75 hrs)
  - Nocturnal haemodialysis, with 6 long nocturnal treatments per week (>6 hrs)

Target weekly urea std Kt/V values according to the various dialysis treatment regimens

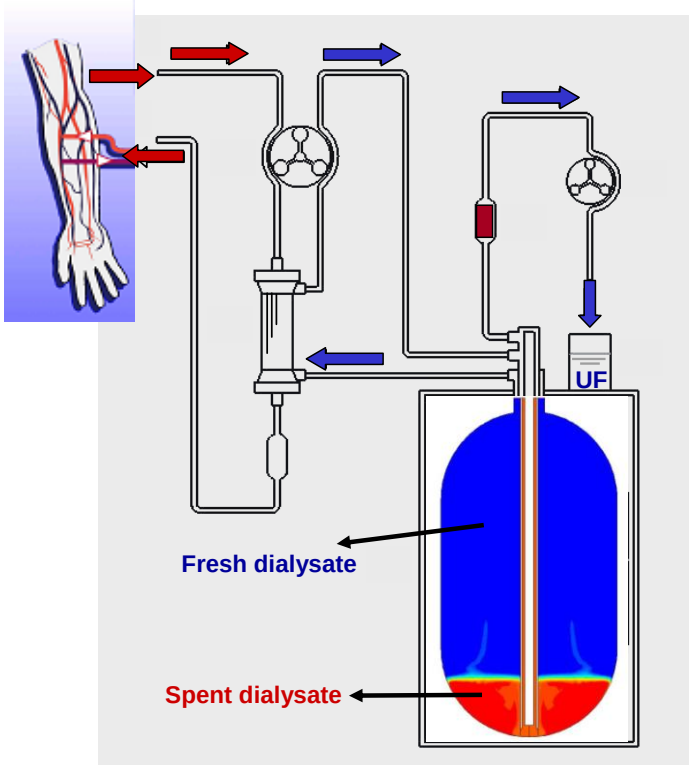
Dialysis treatment regimen	Dialysis treatment frequency	Weekly urea std Kt/V
Peritoneal dialysis	Continuous	1.7–2.0
Conventional hemodialysis	Three times/week	2.1
	Four times/week	2.6–2.9
Short daily hemodialysis	Six times/week	2.7–3.2
Nocturnal hemodialysis	Six times/week	4.6–5.0

Leypoldt et al, SeminDial 17:142–145, 2004

Methods: dialysis strategies

Therefore:

In the present study, we investigated the impact of dialysis time on the removal of uremic toxins, while keeping the processed blood and dialysate volume constant



⇨ 9 patients were submitted to 3 different dialysis sessions:
4, 6, and 8 hours

⇨ using the Genius® single pass batch system + FX80 dialyzer

⇨ adapting pump flow rate: 350, 250, and 180mL/min

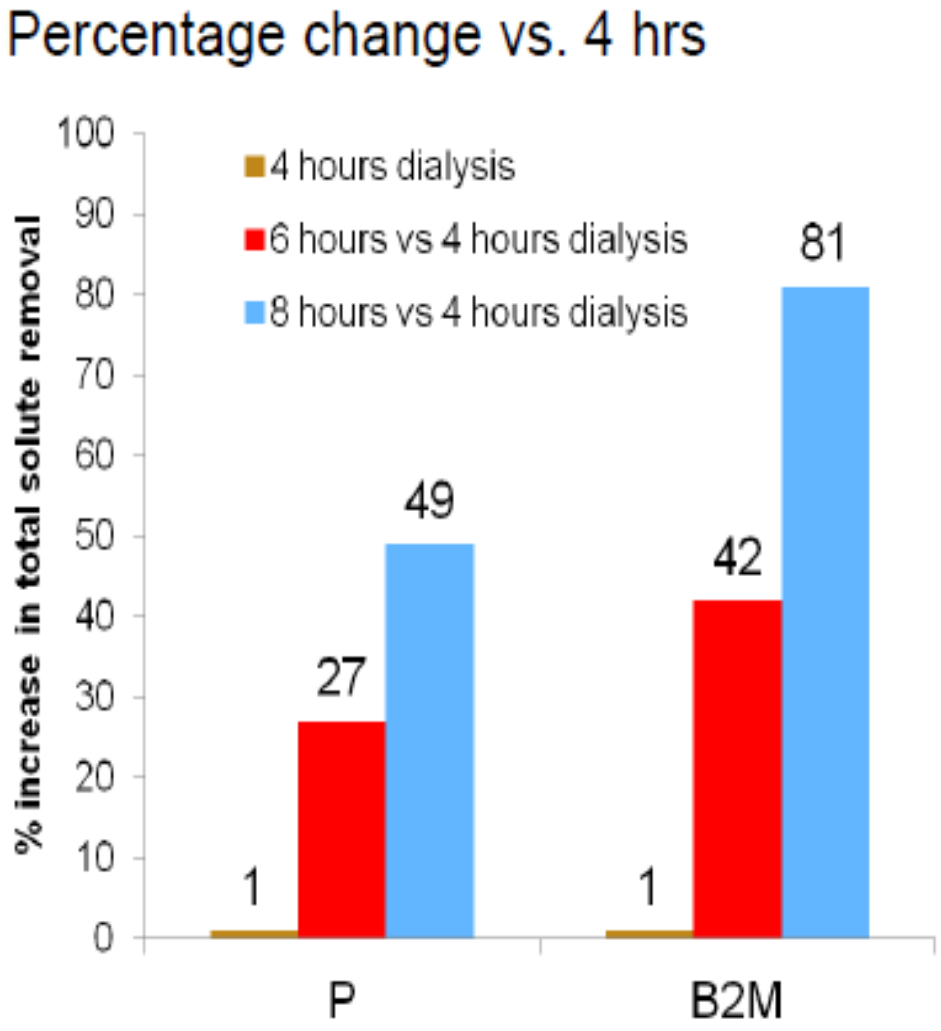
⇨ blood samples were taken from the arterial line at:
4h: 0, 5, 15, 30, 60, 120, and 240min
6h: 0, 5, 15, 30, 60, 120, 240, and 360min
8h: 0, 5, 15, 30, 60, 120, 240, 360, and 480min

⇨ dialysate samples were taken at the end from the UF recipient

⇨ Samples were analyzed for urea, creatinine, phosphorus, and beta2-microglobulin (β_2M)

Eloot et al , Kidney Int 73: 765-770, 2008

Increasing lenght of dialysis session without any other parameter increases removal of bigger molecules

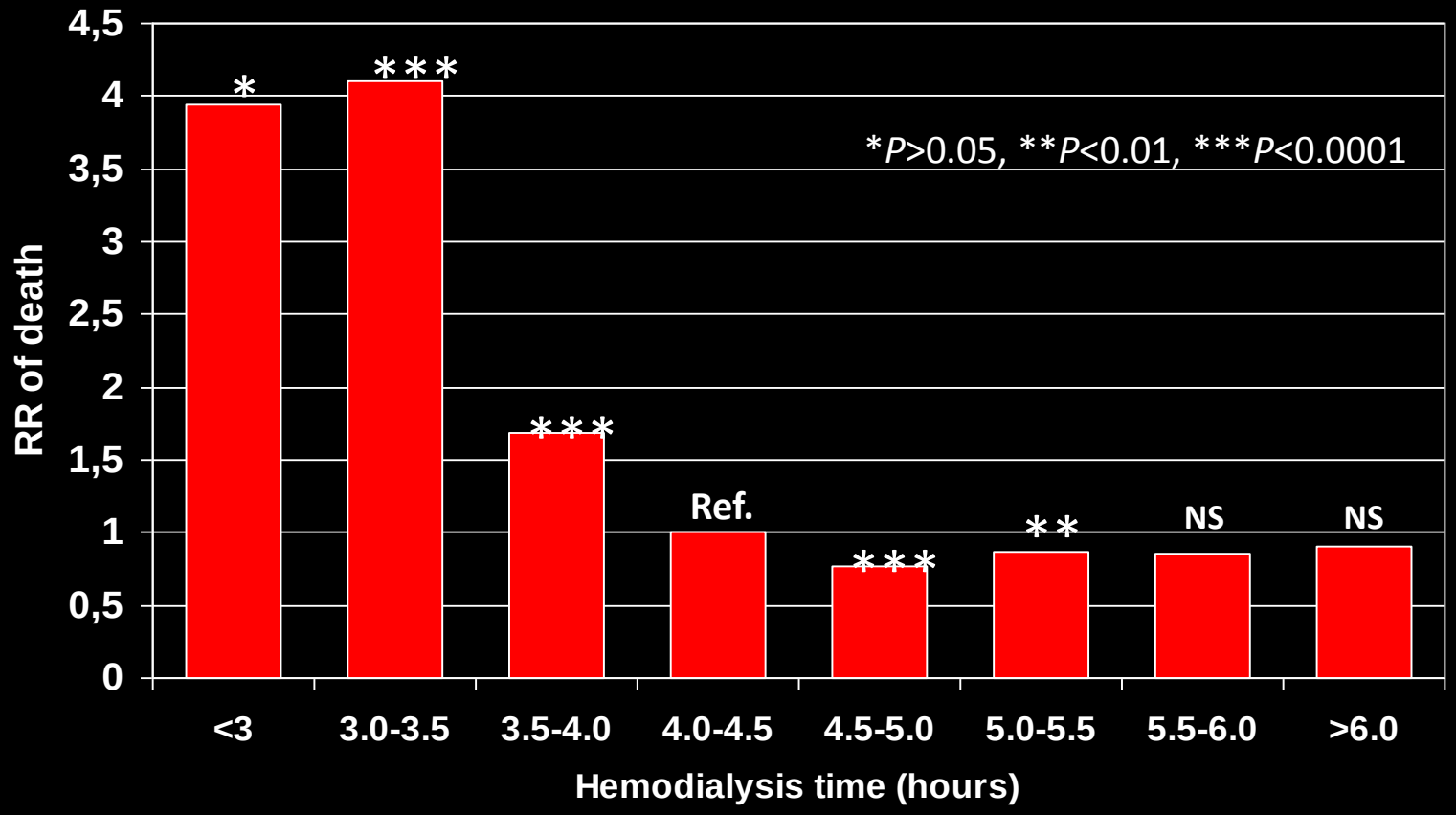


	4 hrs	6 hrs	8 hrs	P
QB and QD	72L	72L	72L	NS
Kt/V	1.4 ±0.3	1.6 ±0.6	1.5 ±0.5	NS

Eloot et al, KI, 73: 765-770; 2007

Treatment time and risk of death

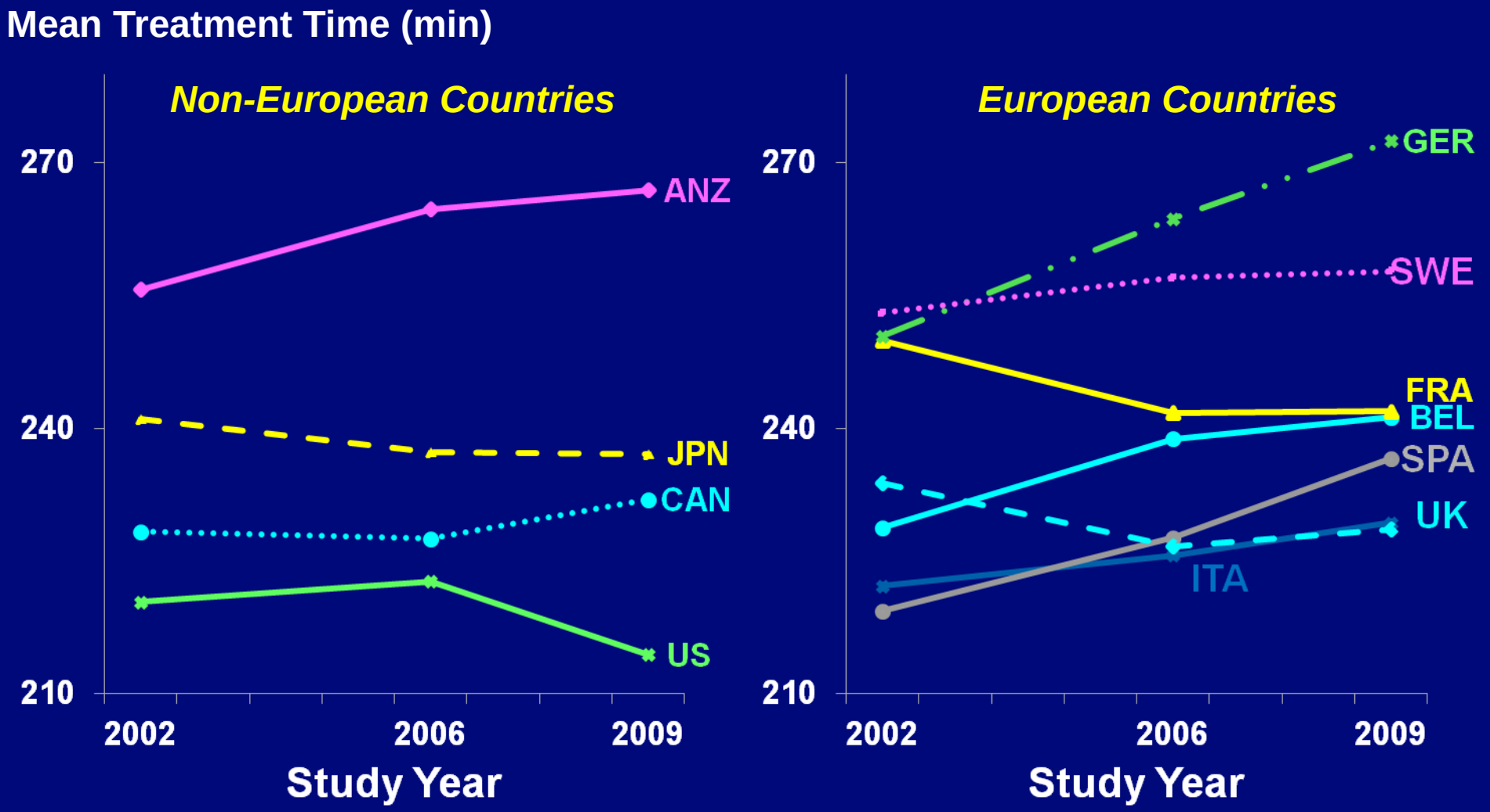
53,867 pts of the Patient Registration Committee of the Japanese Society for Dialysis Therapy



Shinzato et al. Nephrol Dial Transplant 11: 2139-2142, 1996

Treatment Time Trends by Country

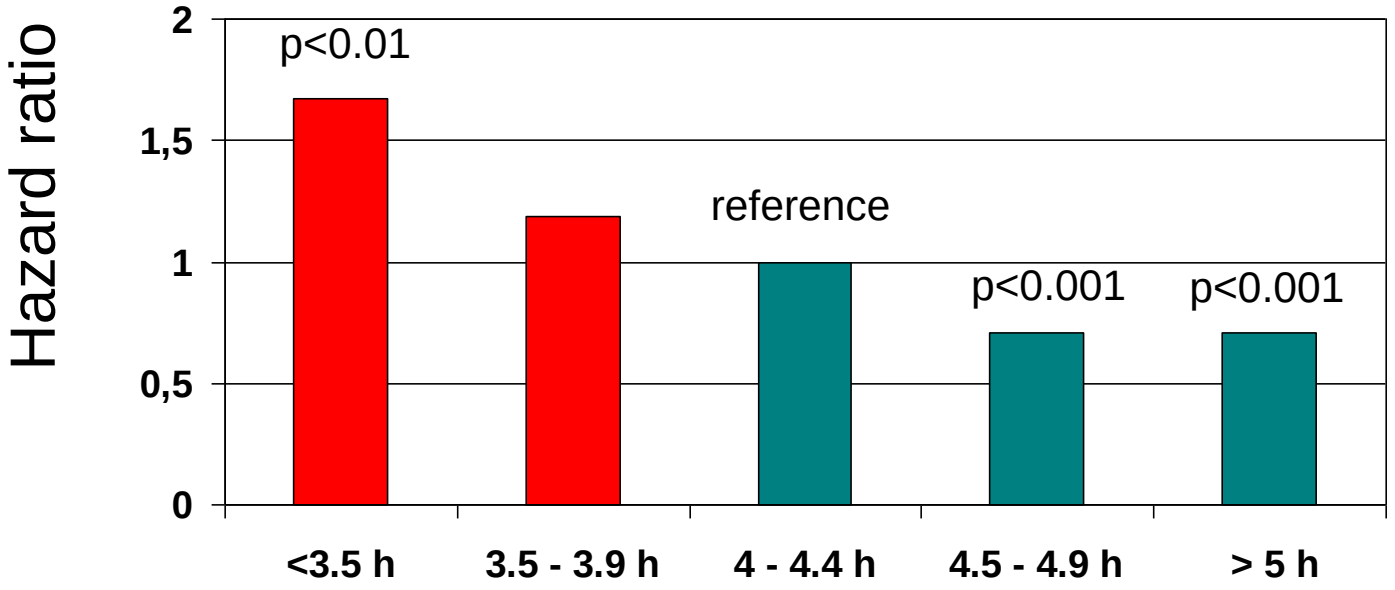
– DOPPS 2-4 Sample Patients (2002-2009) –*



*Initial prevalent cross-sections; DOPPS 4 data are preliminary

Association between length of dialysis session and mortality in Australian patients

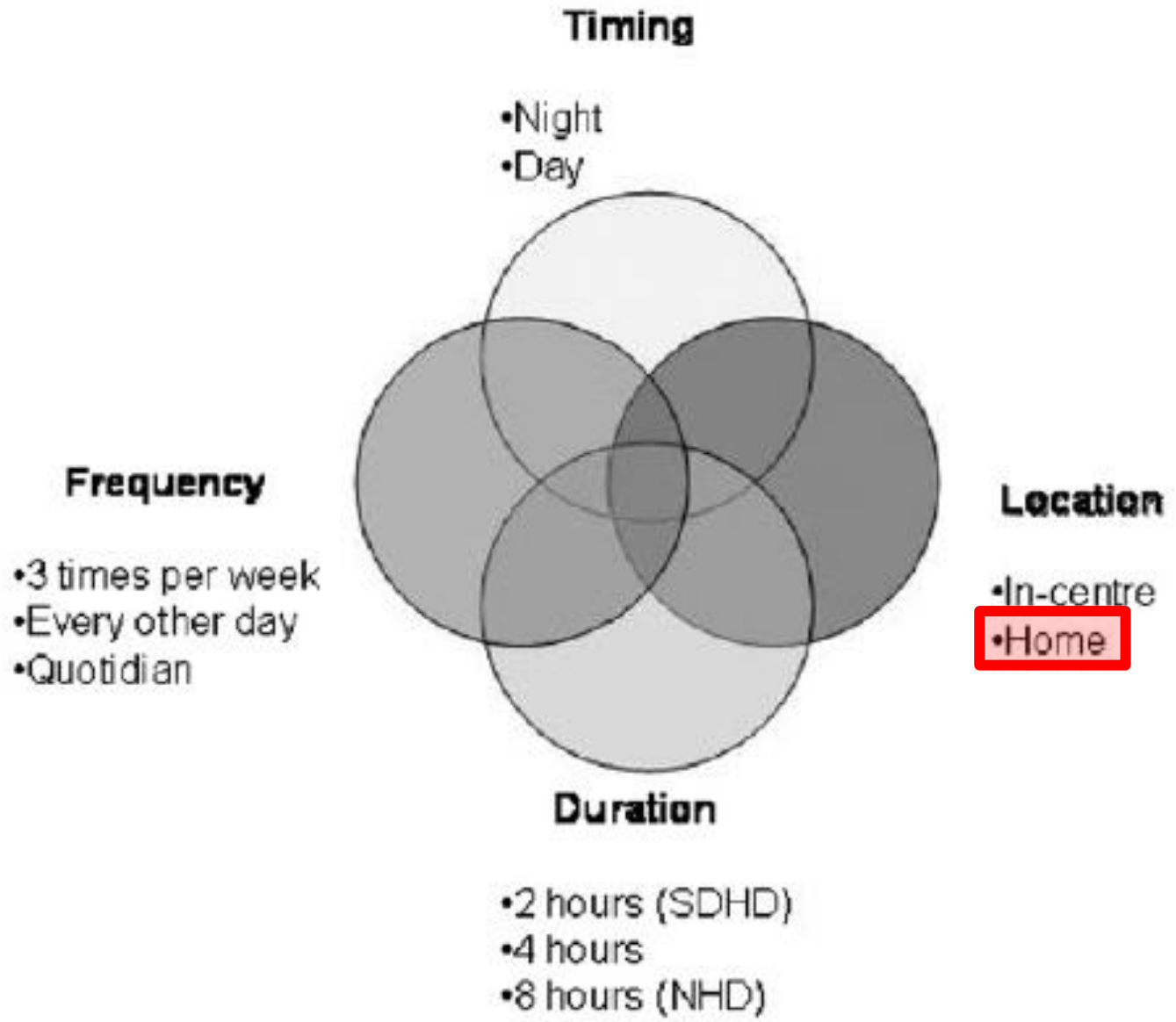
Data from national cohort of 4 193 incident patients on HD



Univariate analysis adjusted for patient demographic and co-morbid medical condöitions and HD session dose

Marshall et al, KI, 2006

Methods of dialysis intensification



Perl, Chan, AJKD 2009, 54: 1171-1184

Comparison of treatment parameters across extended HD schedules

	CHD	SDHD	NHD
Treatments/wk	3	6	5-6
Treatment time (h)	4	2-3	6-8
Blood flow rate (mL/min)	400	400	200
Dialysate flow rate (mL/min)	500	800	300
Single-pool Kt/V/ treatment	1.2	0.5	1.8

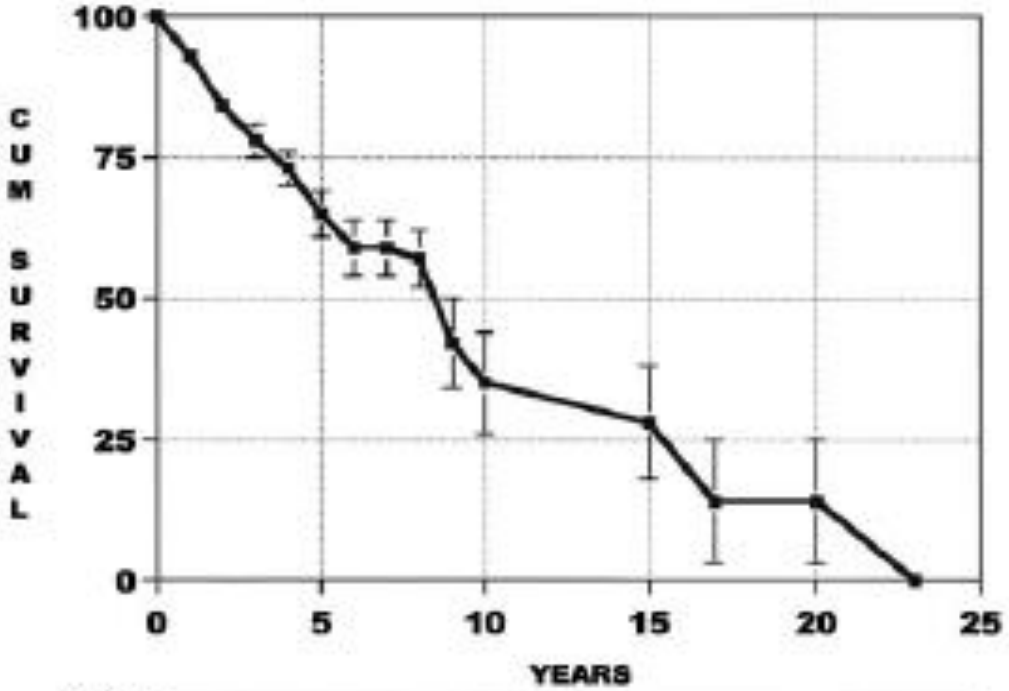
Perl, Chan, AJKD 2009, 54: 1171-1184

Clinical benefits of intensive HD

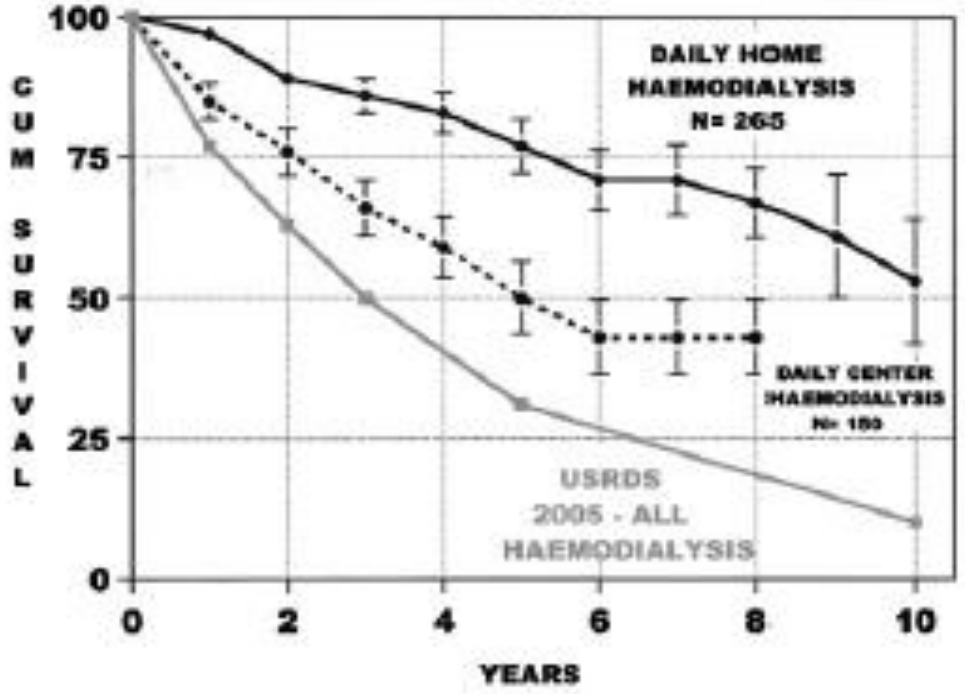
	Nocturnal Hemodialysis	Short Daily Hemodialysis
Blood pressure control	+++ (↓ total peripheral resistance)	++ (↓ extracellular fluid volume)
Left ventricular hypertrophy	+++ (↓ afterload)	++ (↓ preload)
Left ventricular systolic function	+++	Not shown
Arterial compliance	+++	Not shown
Sleep apnea	Correction	Not shown
Cardiac autonomic nervous system abnormalities	Restoration	Not shown
Phosphate control	+++	Depends on duration
Anemia	++ (↓ erythropoietin resistance)	+ (↓ erythropoietin resistance)
Malnutrition	++	++
Inflammation	↓ C-reactive protein, interleukin 6	↓ C-reactive protein
Cognition	+	Not shown
Fertility	++	Not shown
Quality of life	++[a]	++

[a]Improvement in kidney-specific domains of quality of life.

Perl, Chan, Am J Kidney Dis, 54: 2009: 1171-1184



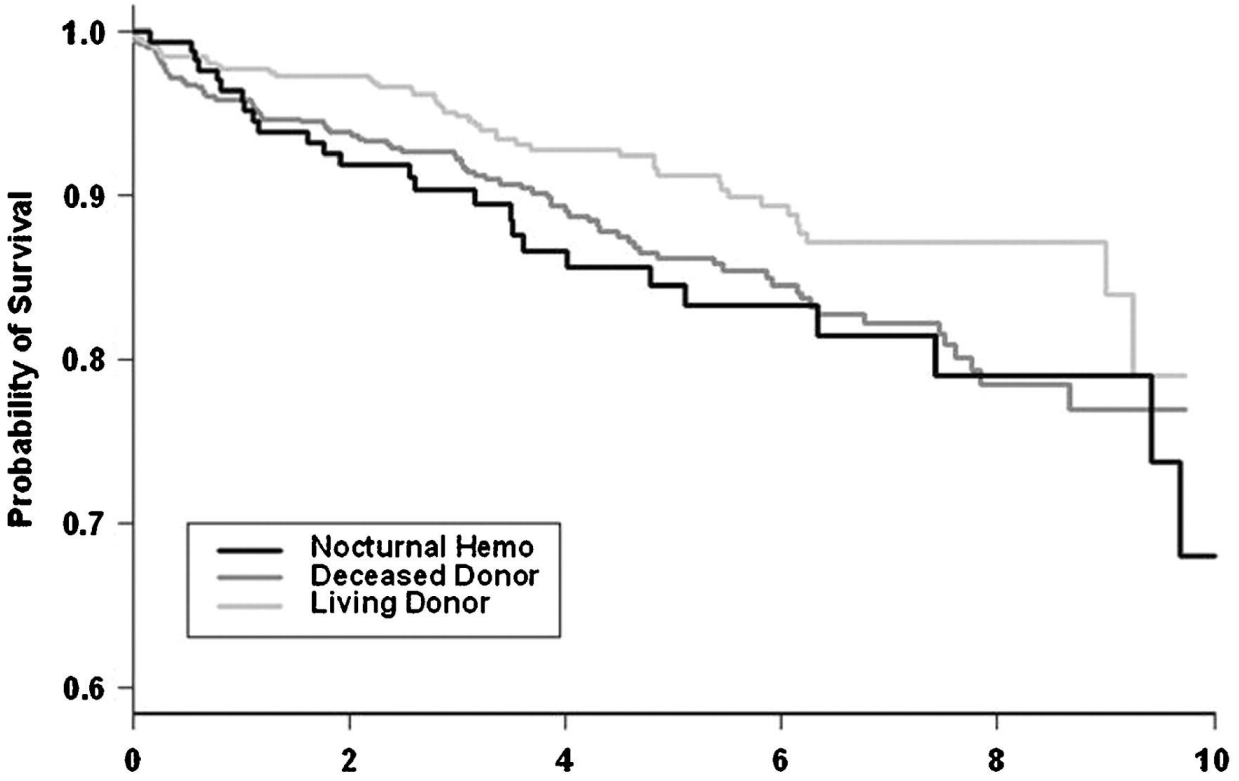
Survival of 415 short daily HD-USA, Italy, France



Survival of the daily HD by site of dialysis (home or daily centre) and compared to the USRDS survival data

Kjellstrand et al, NDT(2008) 23: 3283–3289

Time to death in patients treated with nocturnal haemodialysis, deceased and living donor kidney transplantation (log-rank test, P = 0.03).



N						
NHD	177	134	85	48	28	10
DTX	531	463	302	198	90	0
LTX	531	458	282	170	60	0

Time From Modality Start (Years)

Pauly R P et al. Nephrol. Dial. Transplant. 2009;24:2915-2919

NDT Nephrology Dialysis Transplantation

Survival among nocturnal home HD patients Compared to kidney transplant recipients

Table 3
Association of treatment modality with death

	HR[a]	95% confidence interval	*P*-value
NHD (Reference group)	1		
DTX	0.87	0.50, 1.51	0.61
LTX	0.51	0.28, 0.91	0.02

HR, hazard ratio; NHD, nocturnal haemodialysis; DTX, decease donor transplantation; LTX, living donor transplantation.

Hazard ratios from Cox multivariable regression.

[a]HR: hazard ratio; adjusted for age at NHD start or transplantation, gender, history of ischaemic heart disease/peripheral vascular disease/cancer, study year and duration of conventional dialysis treatment prior to treatment with treatment modality of interest.

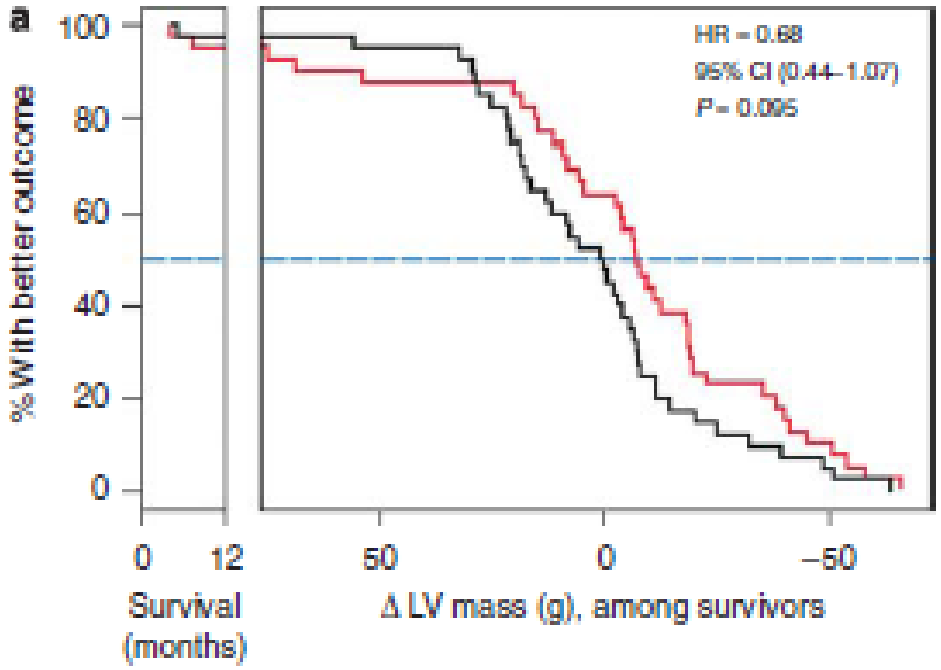
Pauly R P et al. Nephrol. Dial. Transplant. 2009;24:2915-2919

Summary of the 3 RCTs on frequent HD

	Culleton *et al.*	Chertow *et al.*	Rocco *et al.*
Intervention	NDHD versus CHD	In-center DHD versus CHD	NDHHD versus CHD
Study period	August 2004–December 2006	January 2006–March 2010	January 2006–March 2010
Study duration	6 mo	12 mo	12 mo
Randomized patients (*n*)	52	245	87
Included patients (*n*)	22 versus 22 (primary); 26 versus 25 (secondary)	125 versus 120	45 versus 42
h/wk	30–48 versus 10.5–13.5	12.7±2.2 versus 10.4±1.6	30.8±9.1 versus 12.6±3.9
Weekly Kt/V	—	3.54±0.65 versus 2.49±0.27	4.72±1.18 versus 2.59±0.69
Primary outcome measures	Δ LV mass	Death or Δ LV mass; death or Δ physical health composite score	Death or Δ LV mass; death or Δ physical health composite score
Secondary outcome measures	QoL, BP, mineral metabolism, medications	Cognitive performance, depression, nutrition, mineral metabolism, vascular access interventions	Cognitive performance, depression, nutrition, mineral metabolism, vascular access interventions
Primary outcome results	LV mass improves	Significant benefit for both coprimary outcomes	Significant benefit for both coprimary outcomes
Secondary outcome results	Improvement of QoL, BP, abnormalities in mineral metabolism; no effect on anemia control	Improved control of hypertension and hyperphosphatemia; more vascular access interventions	Improved control of hypertension and hyperphosphatemia; trend for more vascular access interventions
	JAMA, 2007	**NEJM, 2010**	**KI, 2011**

Lameire et al, NephSap, December 2012

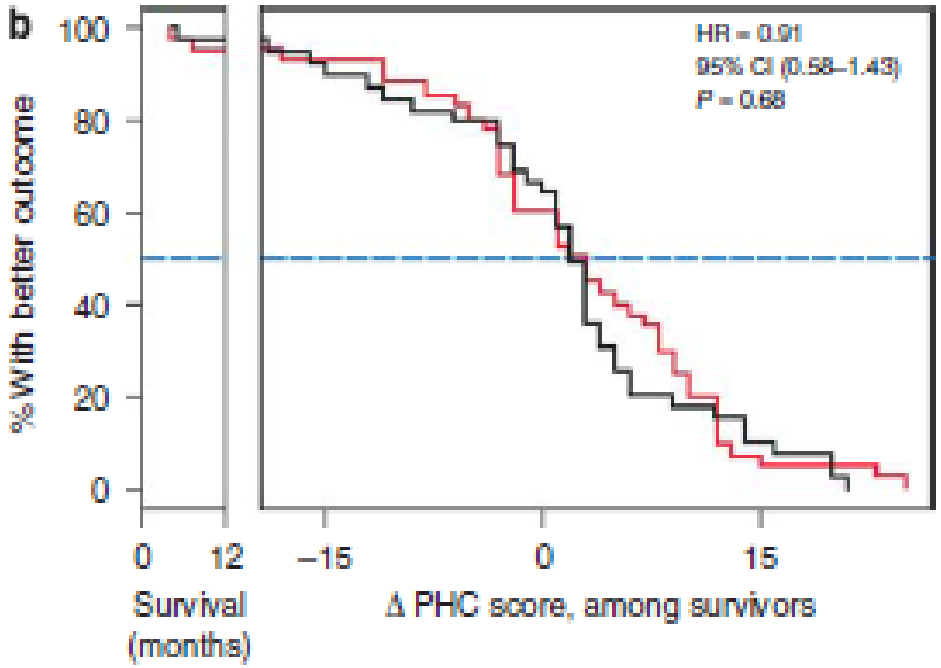
Kaplan-Meier survival curves



Mortality/LV mass composite

Conventional group

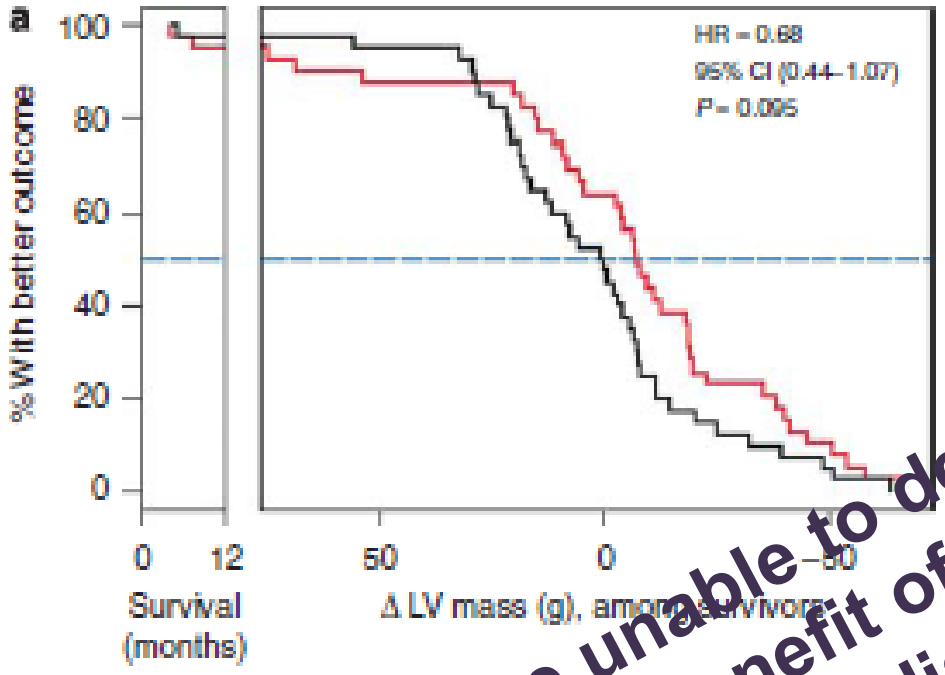
Frequent nocturnal home HD



Mortality/physical health composite

Rocco et al, Kidney Int (2011) 80, 1080–1091

Kaplan-Meier survival curves

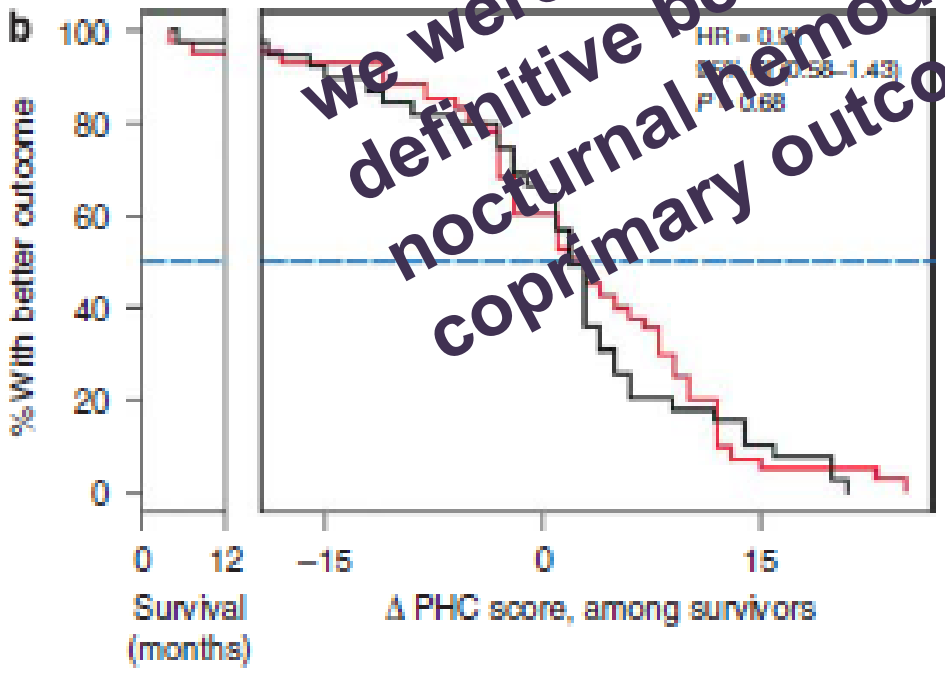


Mortality/LV mass composite

Conventional group

Frequent nocturnal home HD

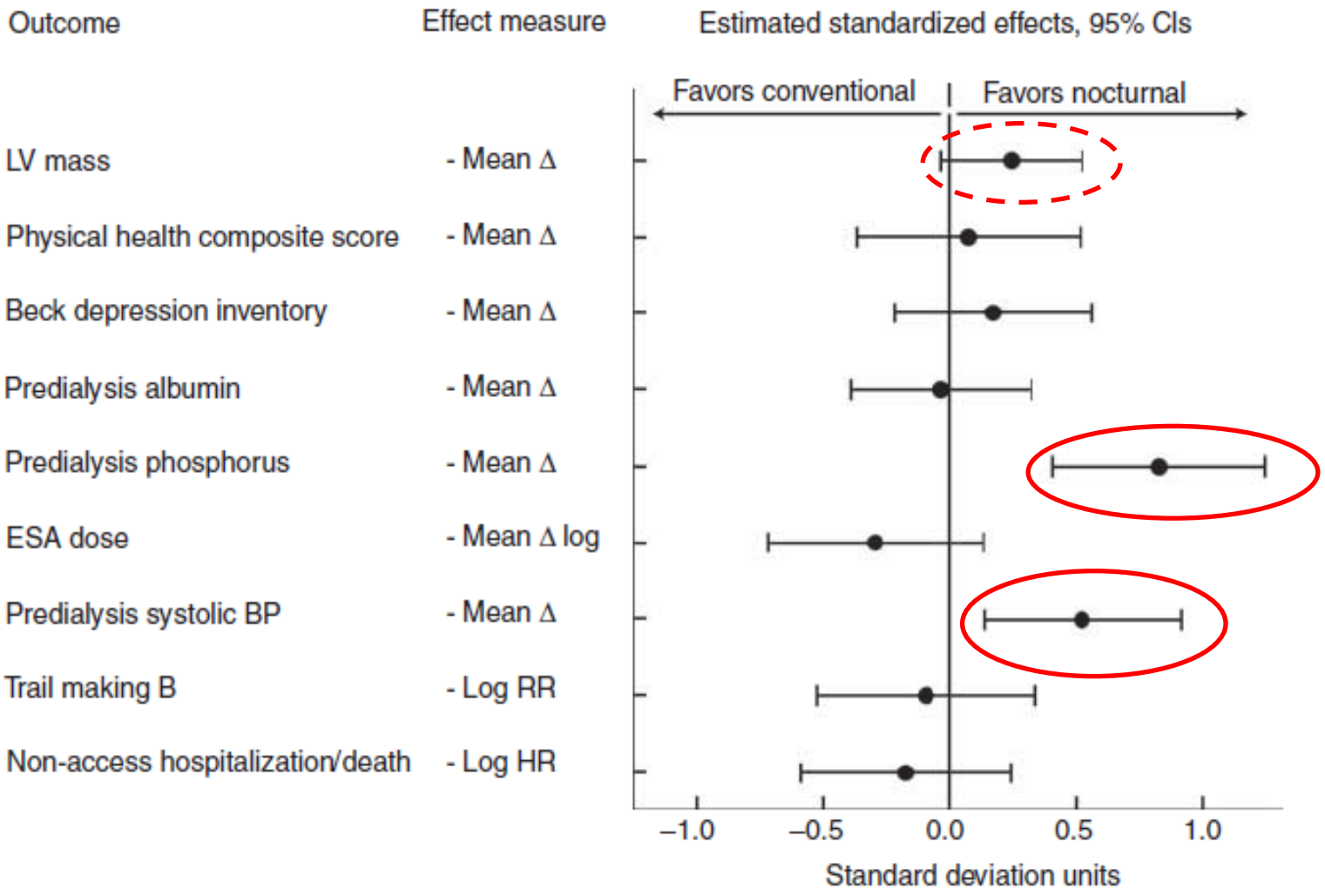
we were unable to demonstrate a definitive benefit of more frequent nocturnal hemodialysis for either coprimary outcome.



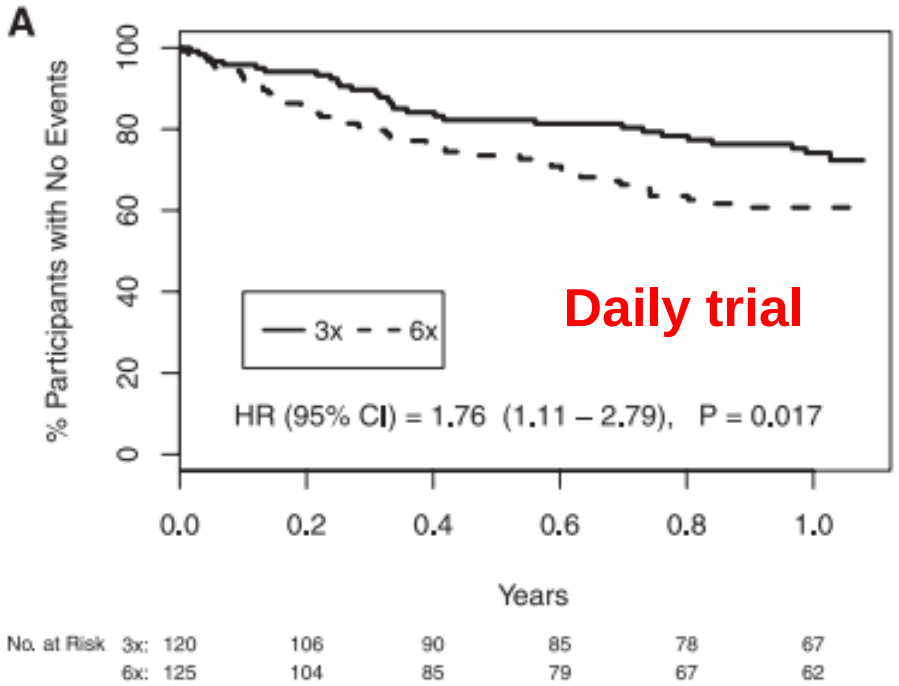
Mortality/physical health composite

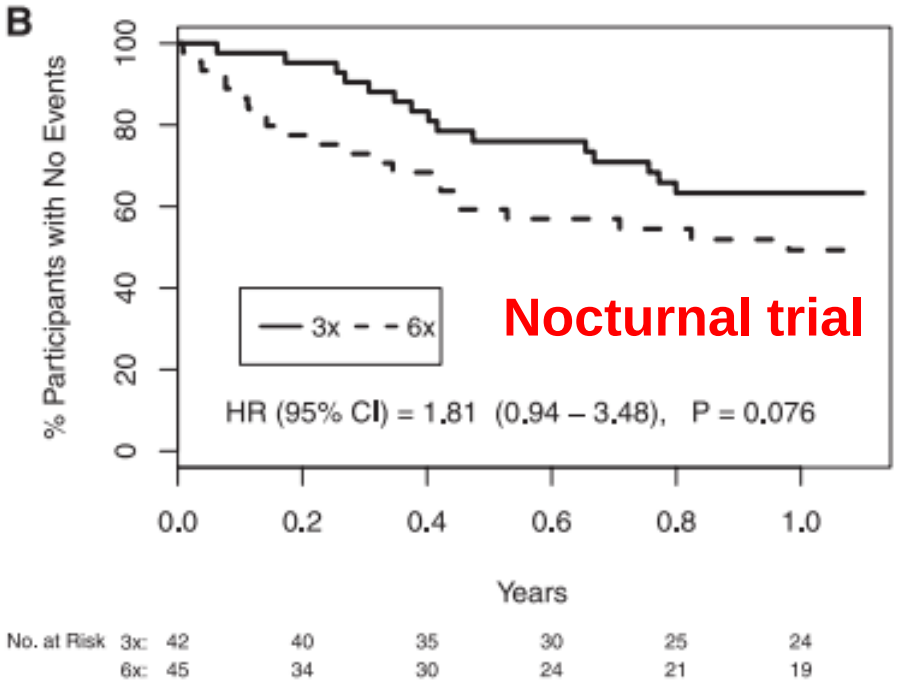
Rocco et al, Kidney Int (2011) 80, 1080–1091

Secondary results of the frequent nocturnal home hemodialysis trial



Rocco et al, Kidney Int (2011) 80, 1080–1091



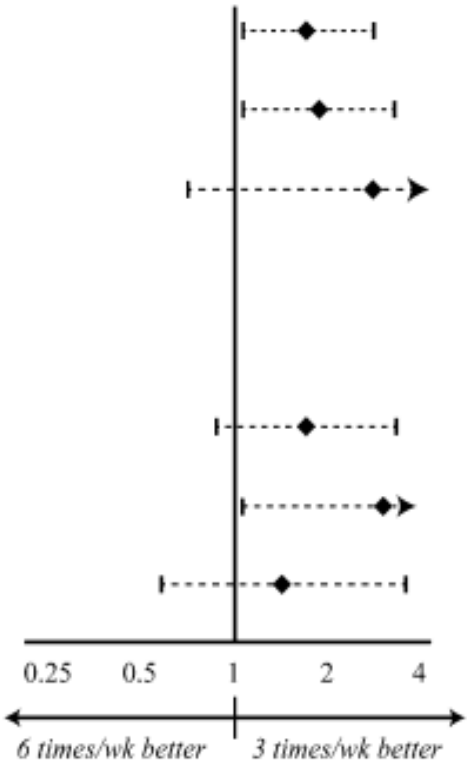


K-M curves of time to first access repair, access loss, or access hospitalization

Suri et al, J Am Soc Nephrol 24: 498–505, 2013.

Forest plot of time to first access repair, access loss, or access hospitalization by trial and access subgroup in daily and nocturnal trials

	3 TIMES PER WEEK			6 TIMES PER WEEK					
	N	Follow-up (yrs)	Event rate*	N	Follow-up (yrs)	Event rate*	HR (95% CI)	Plot of HR, 95% CI	p-value
Daily Trial									
All patients	120	127.8	23	125	121.2	40	1.76 (1.11-2.79)		0.017
AV access	94	101.3	21	104	99.5	37	1.90 (1.11-3.25)		0.020
Catheters	26	18.9	16	21	17.0	47	2.70 (0.71-10.2)		0.14
Nocturnal Trial									
All patients	42	47.1	32	45	39.5	58	1.81 (0.94-3.48)		0.076
AV access	21	24.2	17	25	21.8	55	3.23 (1.07-10.35)		0.038
Catheters	21	19.9	45	20	14.1	71	1.45 (0.59-3.58)		0.42



Suri et al, J Am Soc Nephrol 24: 498–505, 2013.

Patient-perceived barriers in conventional HD to convert to Nightly Home HD

1) Primarily fears of

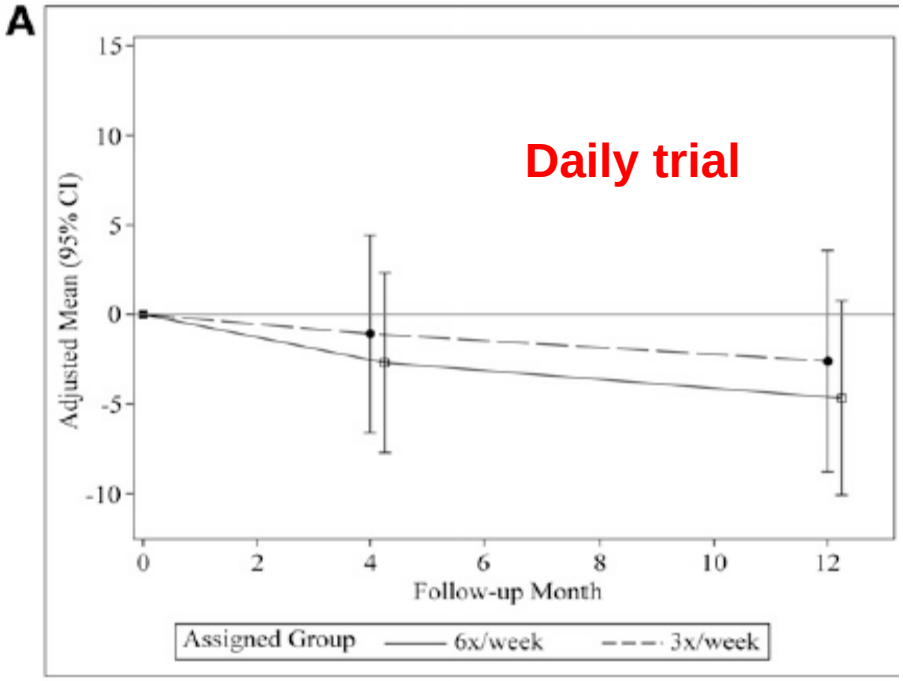
- self-cannulation,
- inability to perform dialysis at home,
- a catastrophic event

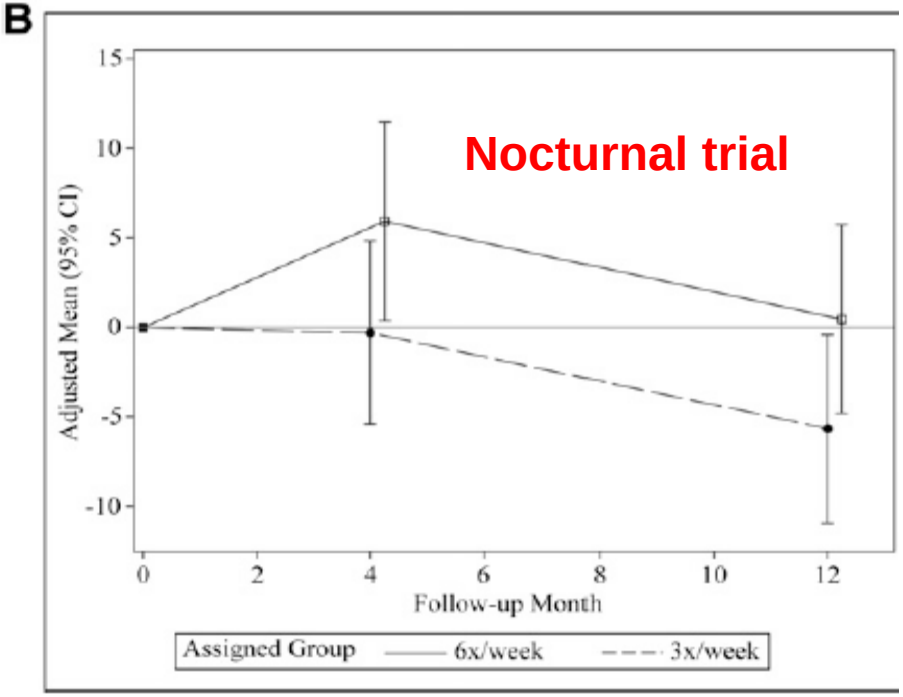
2) Concerns about burden on family

Domain	CHD	NHHD
Self-cannulation ("I will be comfortable inserting the needles by myself")	2.11 (1.55)*	3.57 (1.44)
Quality of care ("I will receive as good care as I would in the hospital")	2.34 (1.48)*	4.10 (1.29)
Self-efficacy ("I will be able to perform the treatment [nocturnal hemodialysis] properly")	2.57 (1.52)*	4.37 (1.19)
Fear of a catastrophic event ("I worry that something will go wrong during my treatment")	3.72 (1.54)*	2.94 (1.47)

Cafazzo et al, Clin J Am Soc Nephrol 4: 784–789, 2009

Effects of Frequent HD on Perceived Caregiver Burden in the Frequent Hemodialysis Network Trials





Changes in perceived Cousineau score over time (higher scores= higher burden

Suri et al, Clin J Am Soc Nephrol 9: 936–942, 2014

Organisational hindrances to home HD

Patient related:

A. Patient/partner willingness to learn
B. Patient-perceived barriers: anxiety,
C. Lack of social support
D. Medical contraindications
E. Poor manual dexterity
F. Poor visual acuity

Treatment related:

lack of functional vascular access and/or fears of self cannulation

Home related:

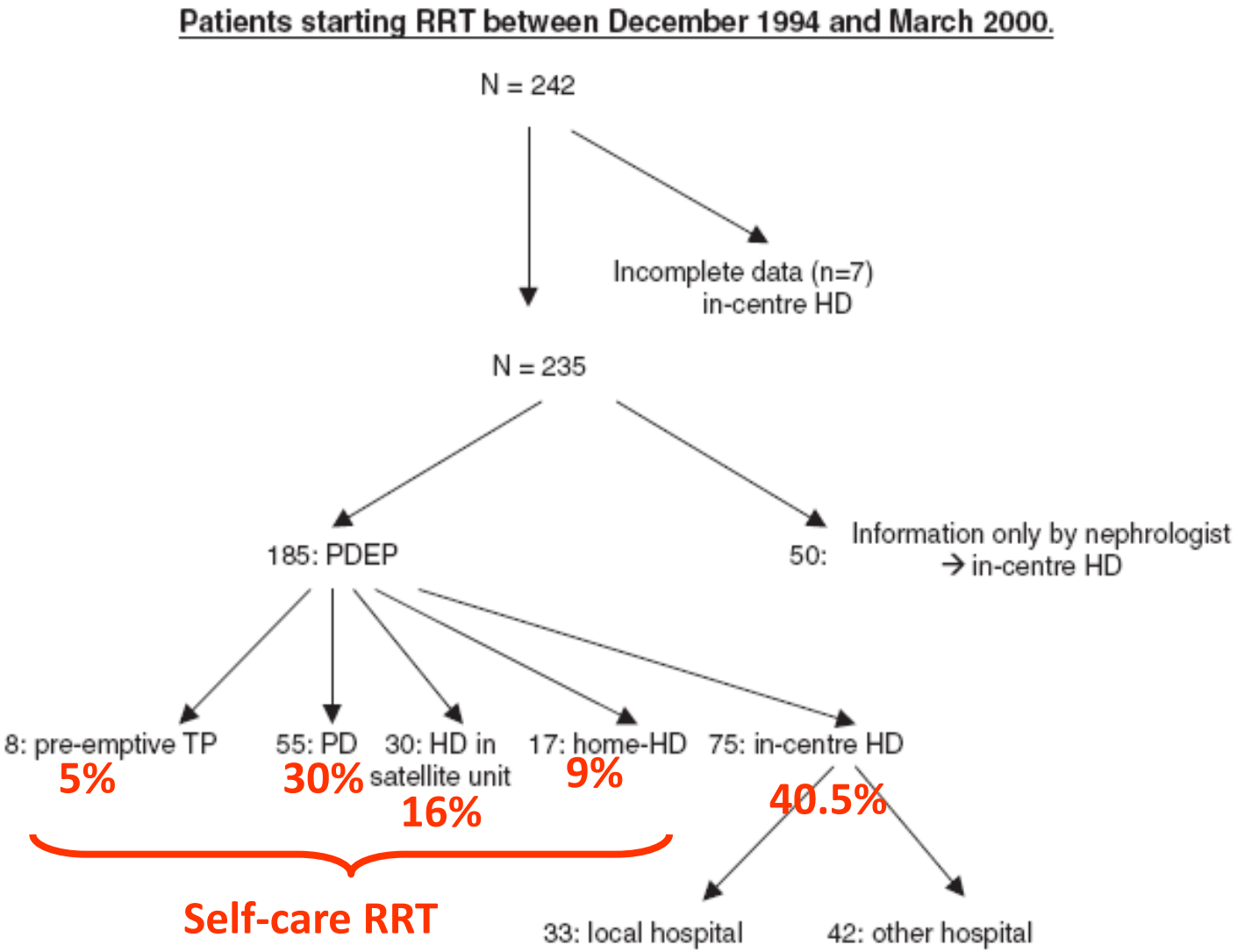
lack of appropriate home environment for HD (ie, space, telephone, lighting, plumbing, waste management).

May be overcome in part with use of novel home dialytic technologies

System related:

A. Lack of experience with home HD in nephrologists and nephrology training programmes
B. Small number of programmes are able to offer home HD
C. Unfavourable financial reimbursement structure
D. Late referral of patients with chronic kidney disease and limited predialysis modality education

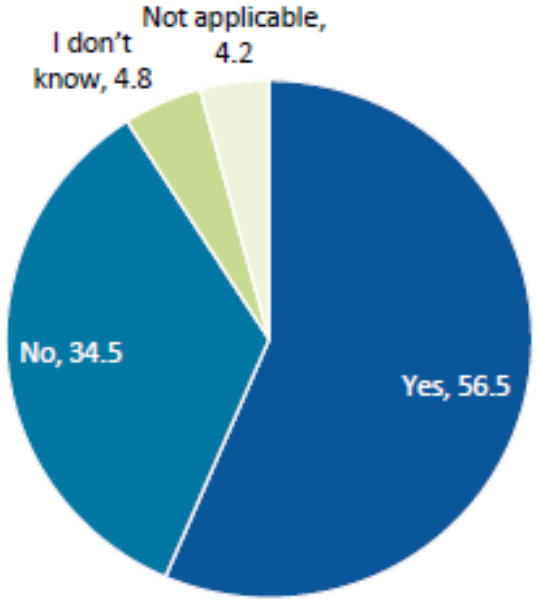
Impact of pre-dialysis education programme on dialysis selection modality



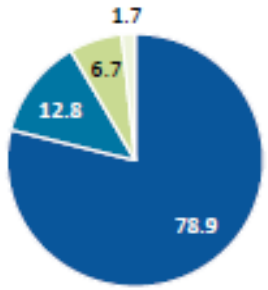
Goovaerts et al, NDT 2005; 20: 1842 - 1847

Information about choice

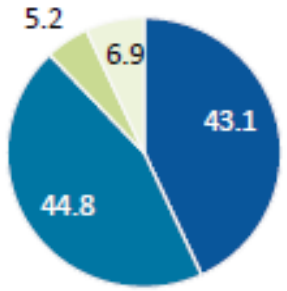
During this treatment time, has anyone ever spoken to you about alternative dialysis options and the possibility of changing treatments?



Hungary



Italy

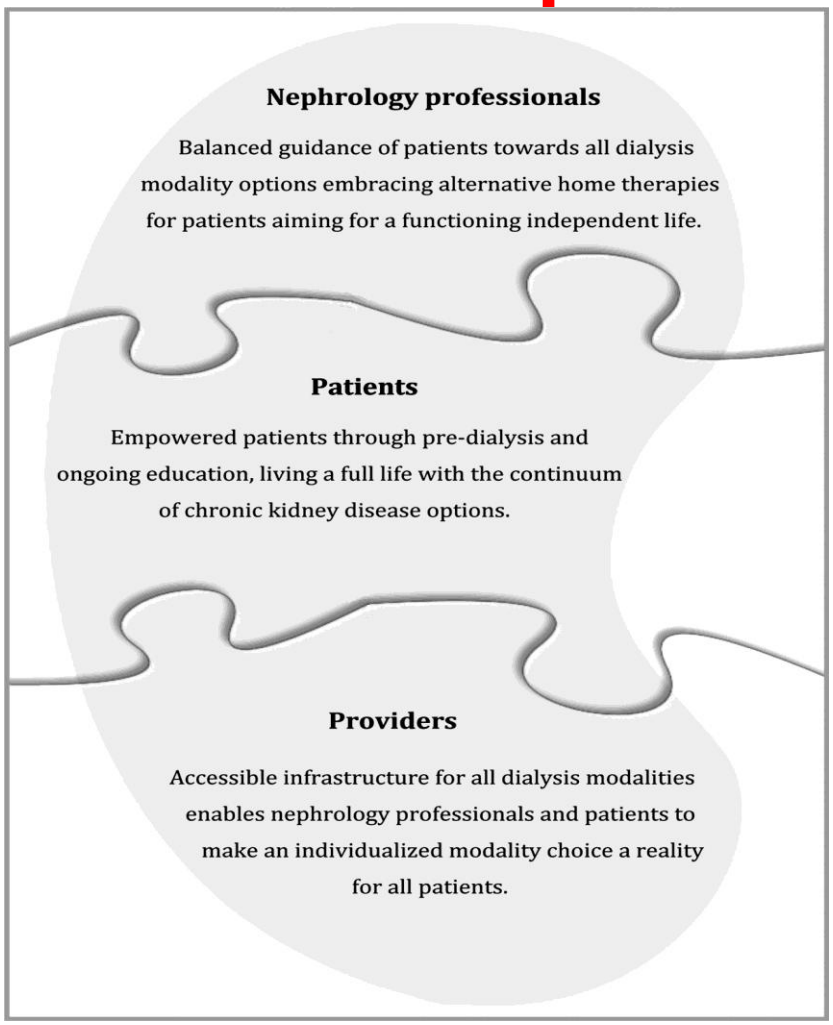


Almost a half of respondents in Europe do not recall having discussed alternative treatment options.

Barriers to Universal and Effective CKD Education

- Delayed referral and/or presentation of patient to nephrologist
- Lack of availability of structured or effective multidisciplinary CKD education programs
- Inadequate physician training in dialysis therapies other than in-center hemodialysis
- Lack of infrastructure to effectively provide alternatives to in-center hemodialysis
- Physician belief of superiority of extra-corporeal dialysis therapies

Paradigm shift: the three critical elements to make home therapy a reality for any interested patient.



Schiller B et al. NDT Plus 2011;4:iii11-iii13

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Reimbursement per week for dialysis services-different countries-USD

	Belgium	Germany	The Netherlands	United Kingdom[a]	France	United States	Ontario, Canada[b]
Self-care hemodialysis	1045[c]	675	1668	744	909	689	502
Home hemodialysis	1045	675	1246/1905[c]	744	816	689	385
CAPD	985	1077	1126	502	718	689	636
APD	985	1077	1126	612	925	689	733
Hospital hemodialysis	1608	675–1131[d]	1668	744	1364[d]	689	745

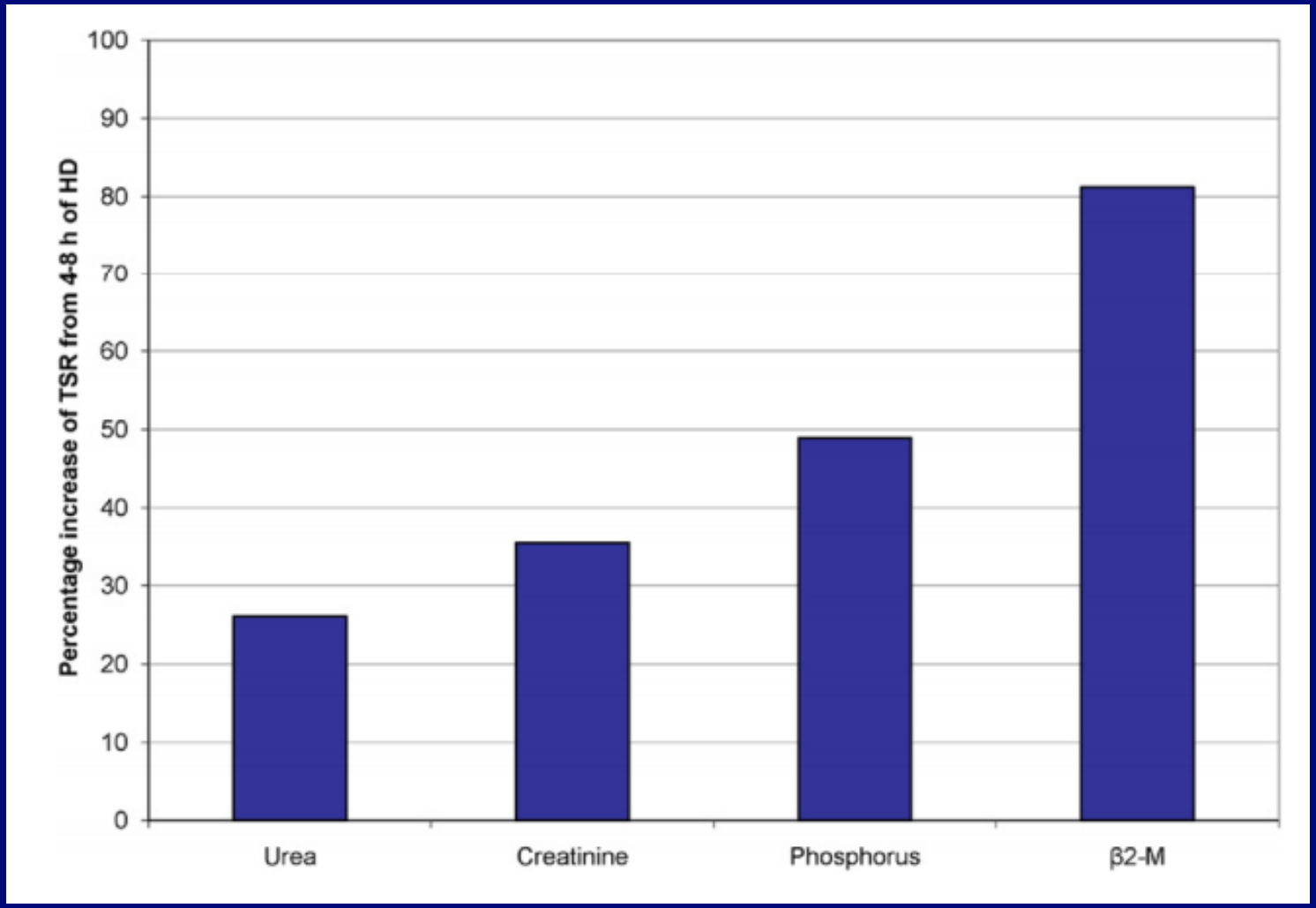
[a]Reimbursement in the United Kingdom corresponds to standard treatment, no hepatitis B/C or HIV, and AVF as access in hemodialysis patients.

[b]Data refer to the province of Ontario only; in Canada, substantial regional differences exist.

[c]The cost is $1246 if hemodialysis is performed with patient's own partner and $1905 if performed with the help of a nursing assistant.

[d]These values are references; regulations for hospital hemodialysis in Germany and France are complex and more extensively explained in the text.

Vanholder et al, J Am Soc Nephrol 23: 1291–1298, 2012


Percentage increase of TSR from 4-8 h of HD
100
90
80
70
60
50
40
30
20
10
0
Urea
Creatinine
Phosphorus
β2-M

Daily HD – Summary of findings of published studies

Variable	*Outcome*	*# studies*
SBP or MAP	Decrease	10 of 11
Serum phosphorus or binder dose	No change	6 of 8
Anemia (Hb, HCT or EPO dose)	Improvement	7 of 11
Serum albumin	Increase	5 of 10
HRQOL	Improvement	6 of 12
Vascular access dysfunction	No change	5 of 7

Suri R. et al. CJASN 2006