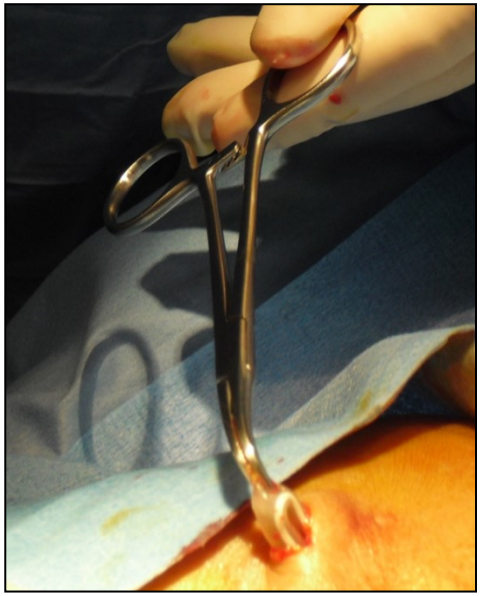
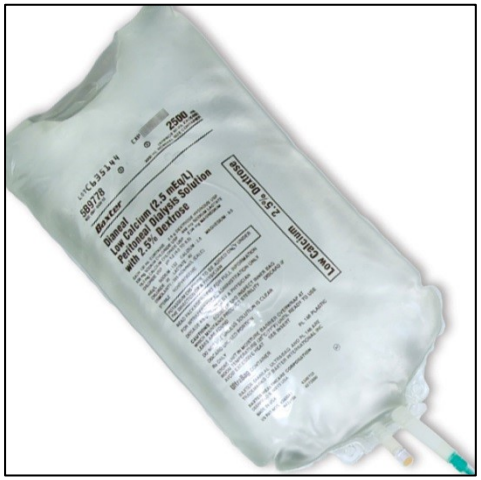
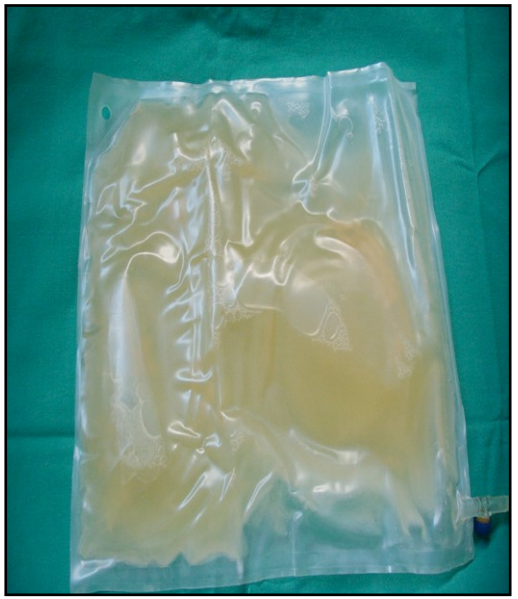
Focus on PD

Roberto Russo

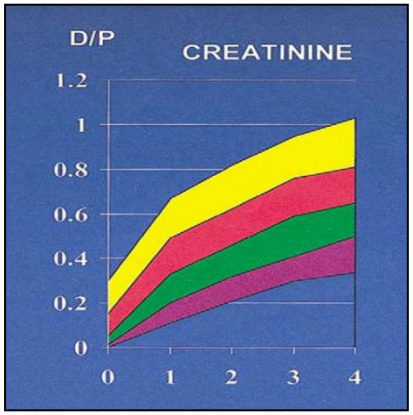
Azienda Ospedaliera
Policlinico di Bari




Low Calcium
2.5% Dextrose
Baxter
Dianeal
Low Calcium (2.5 mEq/L)
Peritoneal Dialysis Solution
with 2.5% Dextrose

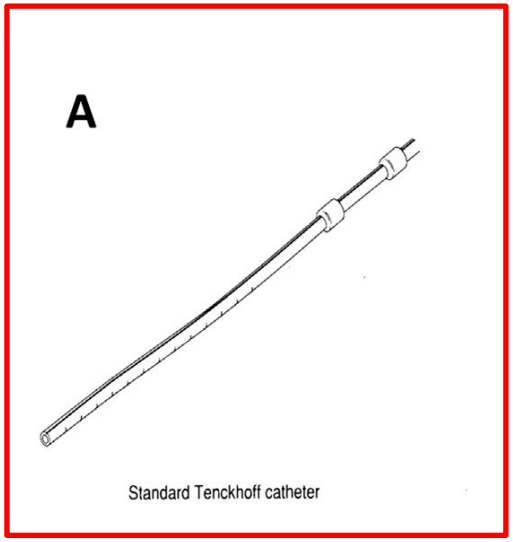


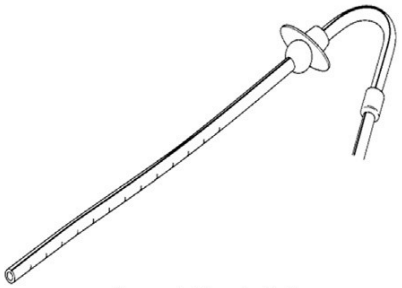

21.02.2014
Version 2.1
02:59:21
harmony
sleep•safe
harmony


D/P
CREATININE
1.2
1
0.8
0.6
0.4
0.2
0
0
1
2
3
4

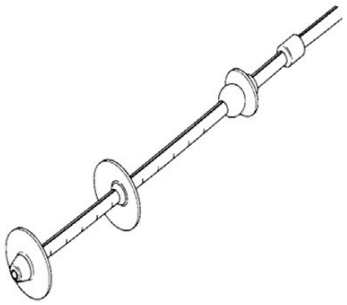

Homechoice Claria

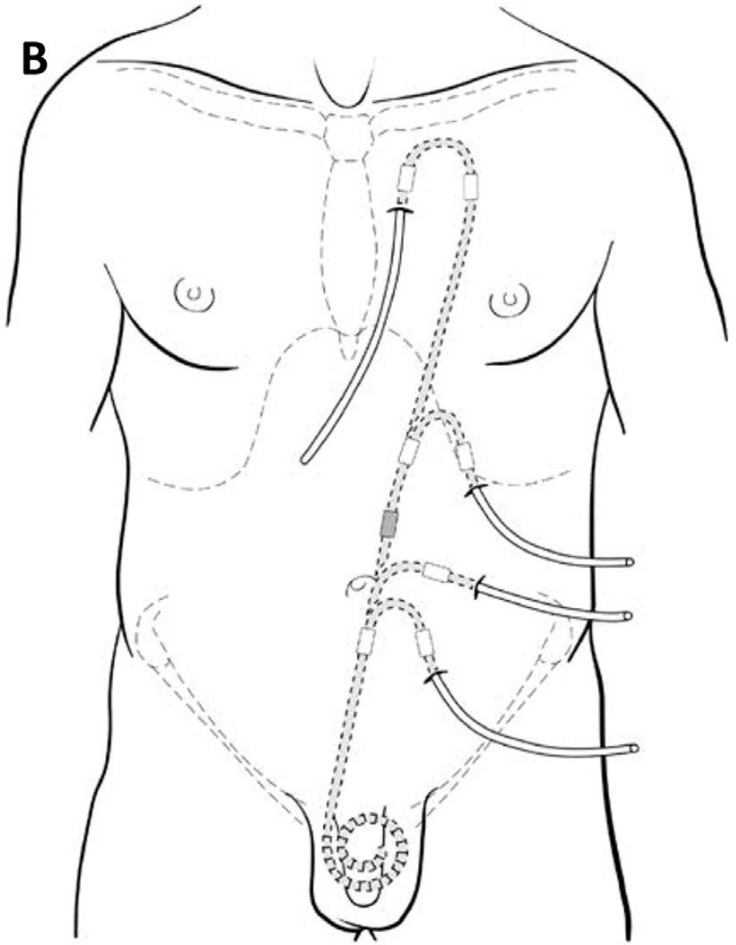
Peritoneal Dialysis Access



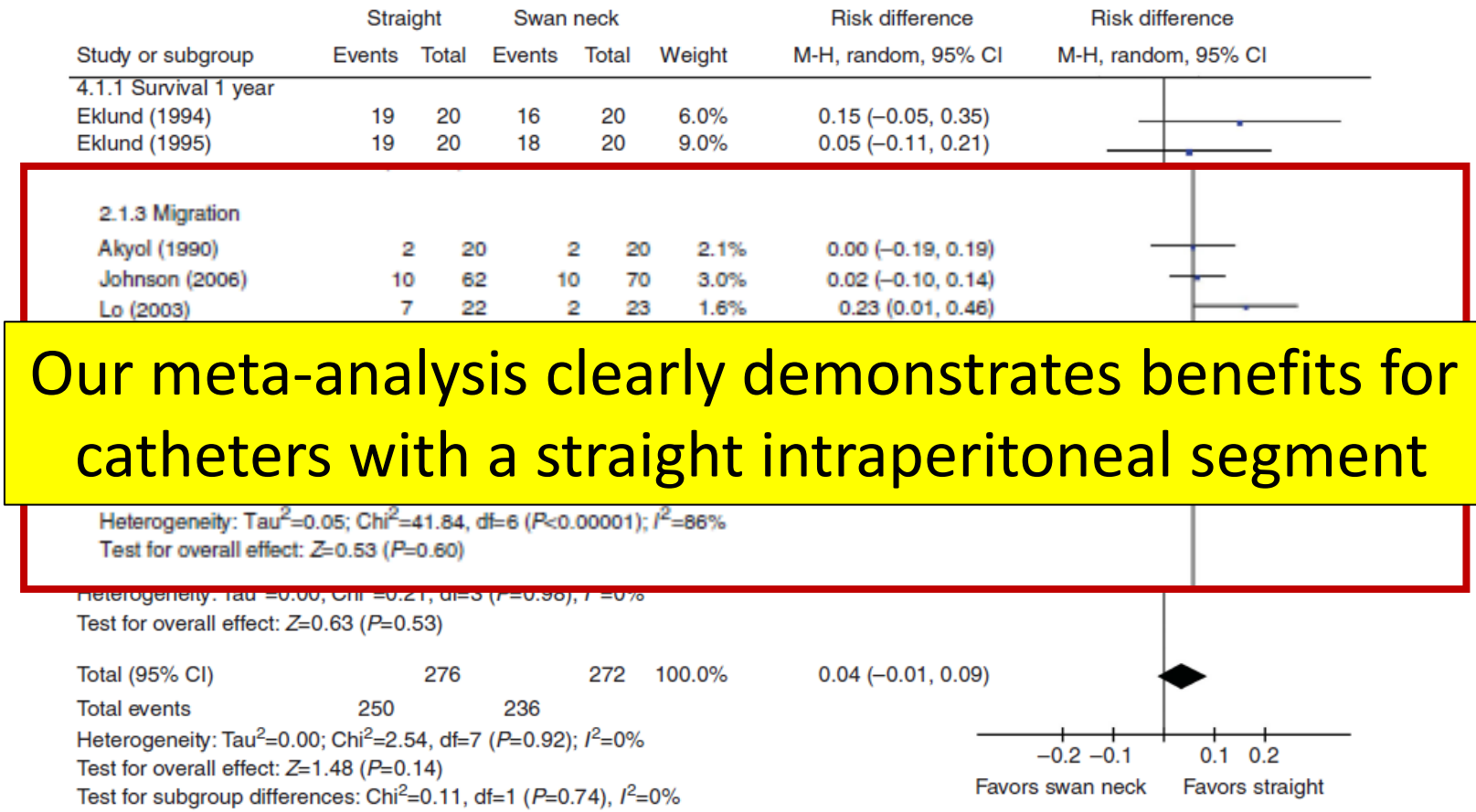

Swan-neck Missouri catheter


Coil catheter


Toronto Western Hospital catheter



A systematic review and meta-analysis of the influence of peritoneal dialysis catheter type on complication rate and catheter survival



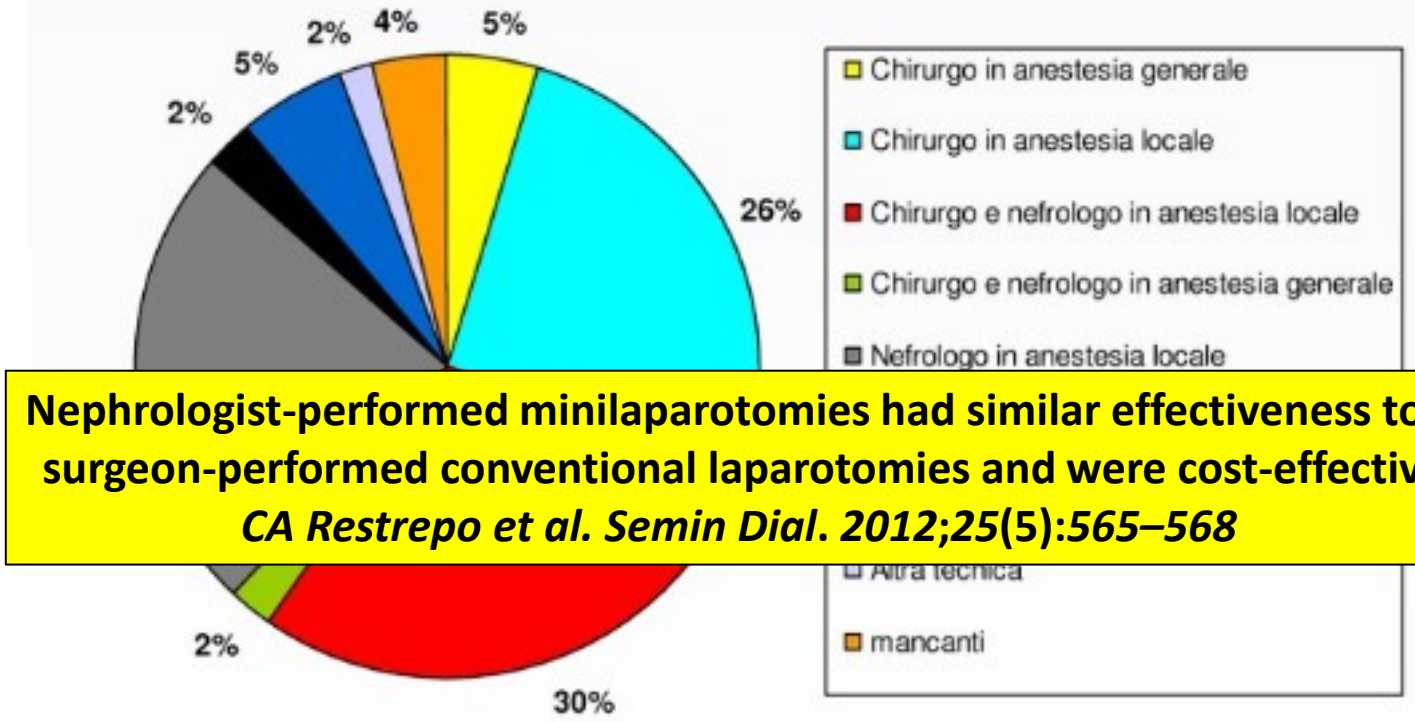
Our meta-analysis clearly demonstrates benefits for catheters with a straight intraperitoneal segment

Figure 4 | Forest plot. Risk difference of the survival rates comparing all analyzed types of peritoneal dialysis catheters.

Kidney Inter (2014) 85, 920–932

CENSIMENTO GSDP 2010

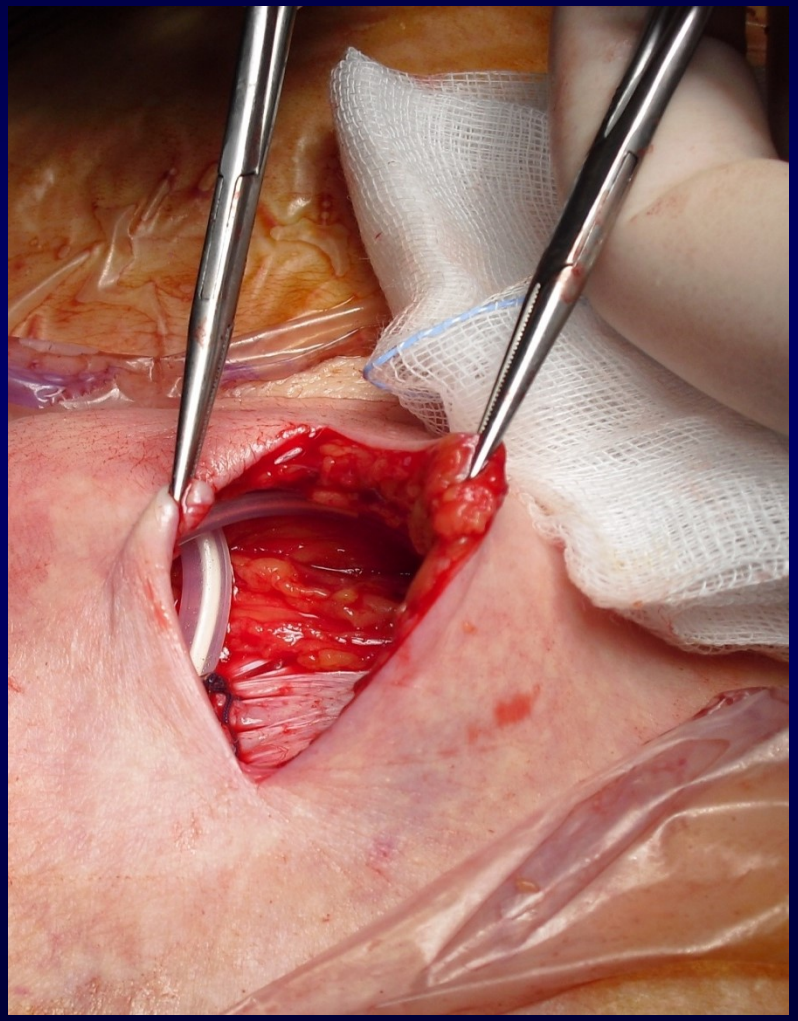
TECNICA DI INSERZIONE (170 CENTRI)

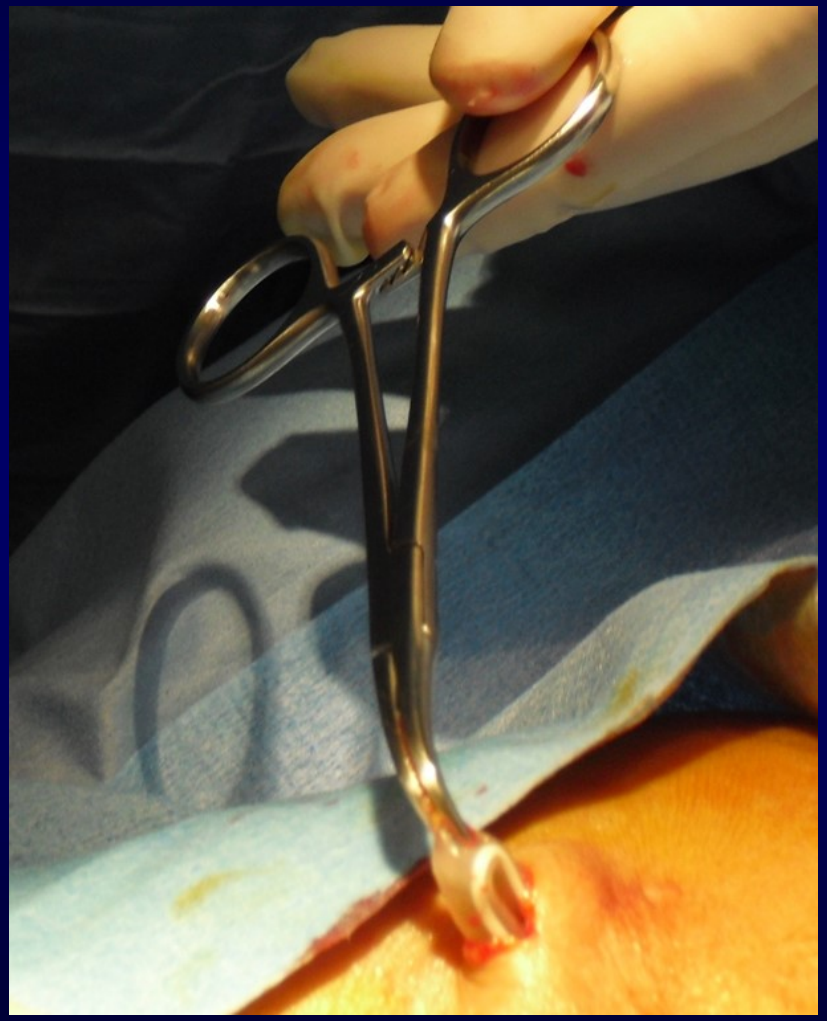


Nephrologist-performed minilaparotomies had similar effectiveness to surgeon-performed conventional laparotomies and were cost-effective
CA Restrepo et al. Semin Dial. 2012;25*(5):*565–568

1) ESCLUSI = centri con un maggior numero di cateteri (INCONGRUENTI) = 54 centri con 340 cateteri attesi e 478 dichiarati
2) per i centri (21) che hanno dichiarato meno cateteri di quelli attesi (-42) li si considera come dati mancanti

PD catheter embedment





PD Solution Formulations

PD Solution	Osmotic Agent	Osm, mOsm/L	pH	No. of Chambers	Lactate, mmol/L	Bicarbonate, mmol/L	GDP Content
Conventional							
Dextrose based (various manufacturers)	Glucose	345-484	5.5	1	35-40	0	High
Glucose sparing							
Extraneal (Baxter)	Icodextrin	282-286	5.5	1	40	0	Low
Nutrineal (Baxter)	Amino acids	365	6.5	1	40	0	Low
Neutral pH, low GDP							
Balance (FMC)	Glucose	358-511	7.0	2	35	2.5	Low
BicaVera (FMC)	Glucose	358-511	7.4	2	0	34	Low
Gambrosol Trio (Gambro)	Glucose	357-483	6.3	3	40	0	Low
Physioneal (Baxter)	Glucose	344-583	7.4	2	10 or 15	25	Medium
Fixioneal (Baxter)	**Glucose**	**345-484**	**7,4**	**2**	**10 or 15**	**25**	**Medium**

Abbreviations: GDP, glucose degradation product; Osm, osmolality; PD, peritoneal dialysis.

Analysis 1.1. Comparison 1 Low GDP (all buffer types) versus standard glucose dialysate, Outcome 1 Residual renal function: 12 months up to 24 months.

Analysis 1.7. Comparison 1 Low GDP (all buffer types) versus standard glucose dialysate, Outcome 7 Urine volume: 12 months to 23 months.

Review: Biocompatible dialysis fluids for peritoneal dialysis

Comparison: 1 Low GDP (all buffer types) versus standard glucose dialysate

Outcome: 7 Urine volume: 12 months to 23 months

Neutral pH, low

Mean

Mean

Based on generally sub-optimal quality studies, use of neutral pH, low GDP PD solution led to greater urine output and higher residual renal function after use exceeded 12 months

Test for overall effect: Z = 3.22 (P = 0.0013)

2 18 months

balANZ Trial 2006 53 957 (822) 59 754 (743) 8.3 % 203.00 [-88.41, 494.41]

Subtotal (95% CI) 53 59 8.3 % 203.00 [-88.41, 494.41]

Heterogeneity: not applicable

Test for overall effect: Z = 1.37 (P = 0.17)

Total (95% CI) 151 146 100.0 % 148.93 [64.92, 232.95]

Heterogeneity: $Tau^2 = 0.0$; $Chi^2 = 0.51$, df = 3 (P = 0.92); $I^2 = 0.0\%$

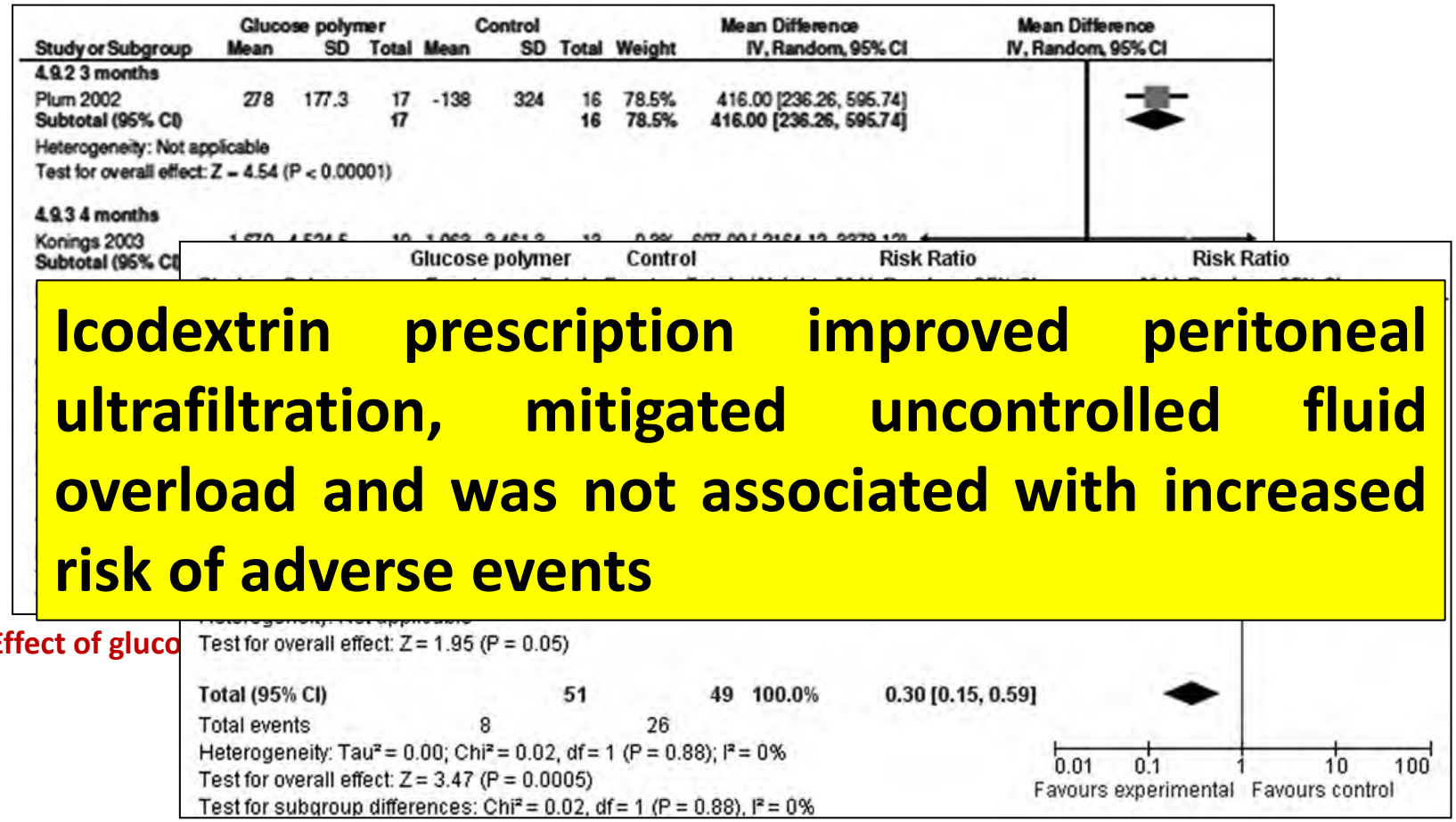
Test for overall effect: Z = 3.47 (P = 0.00051)

Test for subgroup differences: $Chi^2 = 0.14$, df = 1 (P = 0.70), $I^2 = 0.0\%$

-500 -250 0 250 500

Favours standard glucose Favours low GDP

Impact of icodextrin on clinical outcomes in peritoneal dialysis: a systematic review of randomized controlled trials



Icodextrin prescription improved peritoneal ultrafiltration, mitigated uncontrolled fluid overload and was not associated with increased risk of adverse events

Effect of gluco

Effect of glucose polymer PD solution (icodextrin) use on uncontrolled fluid overload episodes

Nephrol Dial Transplant (2013) 28: 1899–1907

Randomized, Controlled Trial of Glucose-Sparing Peritoneal Dialysis in Diabetic Patients

Table 2. Secondary outcomes (IMPENDIA and EDEN studies combined)

Endpoint[a]	Control Group (Dianeal Only)			Intervention Group (P-E-N or D-E-N)			Treatment Difference between Groups[b]	
	Baseline (*n*=127)	Month 3 (*n*=110)	Month 6 (*n*=120)	Baseline (*n*=124)	Month 3 (*n*=91)	Month 6 (*n*=107)	Control–Intervention (95% CI)	*P* Value
Metabolic control								
Total cholesterol (mmol/L)	5.1±1.5	5.2±1.6	5.1±1.6	5.2±1.4	4.8±1.3	4.8±1.3	0.3 (0.0 to 0.7)	0.07
LDL cholesterol (mmol/L)	2.8±1.1	2.9±1.3	2.9±1.3	3.0±1.2	2.7±1.1	2.8±1.1	0.1 (−0.2 to 0.4)	0.59
HDL cholesterol (mmol/L)	1.1±0.4	1.1±0.3	1.0±0.4	1.1±0.3	1.1±0.4	1.1±0.3	0.0 (−0.1 to 0.1)	0.30
VLDL cholesterol (mmol/L)	1.0 (0.2–12.6)	0.9 (0.3–6.0)	0.9 (0.1–7.7)	0.9 (0.3–6.8)	0.8 (0.2–2.7)	0.8 (0.2–3.3)	0.3 (0.1 to 0.5)	0.003
Serum TG (mmol/L)	2.1 (0.4–27.7)	2.1 (0.6–13.2)	2.2 (0.5–16.9)	1.9 (0.6–15.0)	1.8 (0.4–6.0)	1.7 (0.7–7.2)	0.2 (0.2 to 1.1)	0.002
Insulin (pg/ml)	485 (70–3674)	462 (137–3873)	471 (137–6190)	416 (87–7354)	462 (131–4592)	478 (137–8155)	−29.2 (−269 to 211)	0.81
C-peptide (pg/ml)	3745 (69–20058)	3756 (69–20743)	3725 (69–19581)	2744 (69–17287)	3635 (69–22325)	3903 (69–23126)	121 (−928 to 1171)	0.82

Low-glucose dialysis regimen improves metabolic indices in diabetic patients receiving peritoneal dialysis

8.5

Time (months)

Subjects			
Non-glucose sparing	125	107	118
Glucose sparing	119	86	99

J Am Soc Nephrol 24: 1889–1900, 2013

PD Hypertonic Solutions

http://www.kidney-international.org original article

see commentary on page 565

L-Carnitine is an osmotic agent suitable for peritoneal dialysis

Mario Bonomini[1], Assunta Pandolfi[2], Lorenzo Di Liberato[1], Sara Di Silvestre[2], Yvette Cnops[3], Pamela Di Tomo[2], Mario D'Arezzo[1], Maria P. Monaco[1], Annalisa Giardinelli[2], Natalia Di Pietro[2], Olivier Devuyst[3] and Arduino Arduini[4]

[1]Department of Medicine, Institute of Nephrology, University 'G. d'Annunzio', Chieti-Pescara, Italy; [2]Department of Biomedical Sciences, University 'G. d'Annunzio', Aging Research Center, Ce.S.I., 'G. d'Annunzio' University Foundation, Chieti-Pescara, Italy; [3]Division of Nephrology, Université Catholique de Louvain Medical School, Brussels, Belgium and [4]Department of Research and Development, CoreQuest Sagl, Tecnopolo, Bioggio, Switzerland

Kidney Int (2011) 80:645-54

see original article on page 645

L-Carnitine: more than just an alternative to glucose as an osmotic agent for peritoneal dialysis?

Simon J. Davies[1,2]

Glucose toxicity remains a concern for long-term membrane function and metabolic side effects in peritoneal dialysis. Partial substitution of L-carnitine as an alternative but similarly effective osmotic agent is an attractive proposition, and, given once daily with glucose, it achieves equivalent ultrafiltration and plasma concentrations that are likely to be safe. The possibility that it can counter glucose-mediated injury to the aquaporin pathway, thus enhancing ultrafiltration, is an intriguing bonus that requires further study.

Kidney International (2011) **80,** 565–566. doi:10.1038/ki.2011.171

ARTICLE IN PRESS

AJKD

Original Investigation

Effect of an L-Carnitine–Containing Peritoneal Dialysate on Insulin Sensitivity in Patients Treated With CAPD: A 4-Month, Prospective, Multicenter Randomized Trial

Mario Bonomini, MD,[1] Lorenzo Di Liberato, MD,[1] Goffredo Del Rosso, MD,[2] Antonio Stingone, MD,[3] Giancarlo Marinangeli, MD,[4] Agostino Consoli, MD,[5] Silvio Bertoli, MD,[6] Amedeo De Vecchi, MD,[7] Emanuele Bosi, MD,[8] Roberto Russo, MD,[9] Roberto Corciulo, MD,[9] Loreto Gesualdo, MD,[9] Francesco Giorgino, MD,[10] Paolo Cerasoli, MD,[11] Augusto Di Castelnuovo, PhD,[12] Maria Pia Monaco, MD,[1] Ty Shockley, ScD,[13] Claudia Rossi, PhD,[14] and Arduino Arduini, MD[15]

***AJKD* (2013) 62: 929-38.**

J Nephrol
DOI 10.1007/s40620-014-0076-x

ORIGINAL ARTICLE

L-Carnitine status in end-stage renal disease patients on automated peritoneal dialysis

Lorenzo Di Liberato · Arduino Arduini · Claudia Rossi · Augusto Di Castelnuovo · Cosima Posari · Paolo Sacchetta · Andrea Urbani · Mario Bonomini

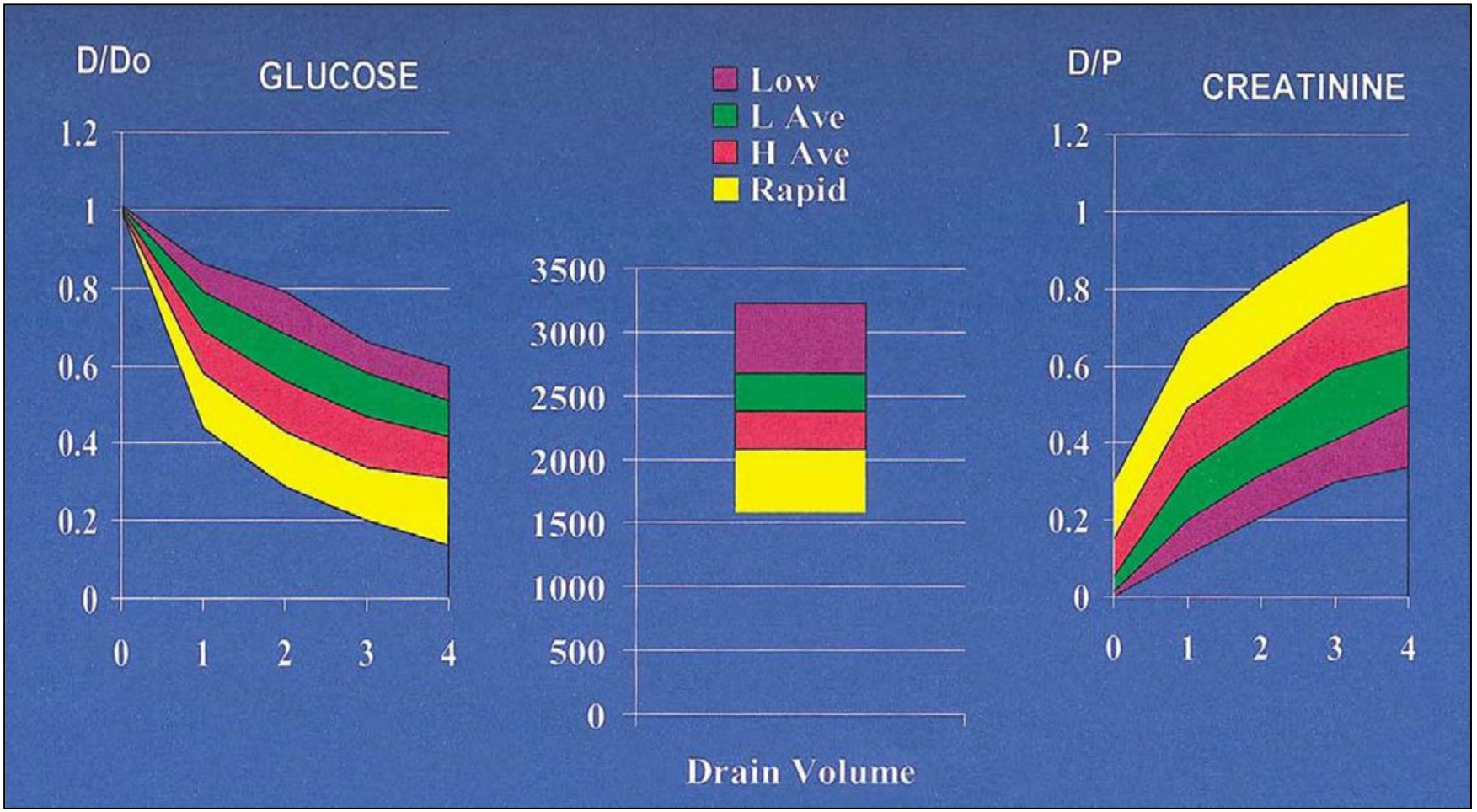
J Nephrol (2014) In the press

Target di Adeguatezza in PD

	Kt/V	CrCL / 1.73	UF
Europa [1]	≥ 1.7	≥ 45 L*	1.00 L
Stati Uniti [2]	≥ 1.7	----	----
Australia [3]	≥ 1.6	≥50-60 L	----
Regno Unito [4]	≥ 1.7	≥50 L	0.75 L
ISPD [5]	≥ 1.7	≥45 L*	----
Italia [6]	≥ 1.8	≥54 L	----
Canada [7]	≥ 1.7	----	----
Giappone [8]	≥ 1.7	----	----

GB Virga J Nephrol 2013

Peritoneal equilibrium test (PET)



Test basati sui principi del PET

- PET Modificato (3.86%-PET)
- Standard Peritoneal Permeability Analysis (SPA)
- Mini-PET e Doppio Mini-PET
- PET Modificato con un drenaggio temporaneo
- PET-Unico (Uni-PET) (Doppio Mini-PET integrato con il 3.86%-PET)
- Altri test (es. Dialysis Adequacy and Transport Test or DATT; APEX)

Vantaggi e limiti dei vari test funzionali peritoneali

Test	Application/advantages	Limitations
Original PET (2.27%) [12,13,38–40]	Small-solute transport, expressed as D/P value Categories fast/average/slow should guide prescription management (see Table 1) Widely used Definition of UF failure	Limited information No information on sodium sieving,
Modified PET (3.86% glucose) [41]	Si… expre… Categories fast/average/slow should guide prescription management (see Table 2) Information on sodium sieving Recommended for definition of UF failure	…mation on FWT or OC
APEX (accelerated peritoneal examination test) [42]	**Apex time**, being the moment when the curves of D/D_0 glucose and D/P_{creat} cross Very suitable to define 'optimal dwell time' for individual patients	No information on sodium sieving, FWT or OC
PDC® (Peritoneal Dialysis Capacity) test [34,35,43–45]	More reliable data because more measuring points Small-solute transport, expressed as area over diffusion distance (A_0/dX). Easily convertible to D/P values Large pore flow Estimate of net peritoneal fluid loss (peritoneal reabsorption) Computer-aided prescription management	Multiple laboratory test needed Computer support for calculations needed
Mini PET [15,21]	FWT It lasts only 1 h	Small-solute transport difficult to interpret No information on peritoneal … OC
Double mini PET[23]	F… OC It lasts only 2 h	…t difficult No information on peritoneal reabsorption
Modified PET with temporary drainage	Small-solute transport, expressed as D/P value Categories fast/average/slow should guide prescription management (see Table 1) Information on sodium sieving, FWT	No information on OC No information on peritoneal reabsorption rate

FWT, free water transport; OC, osmotic conductance.

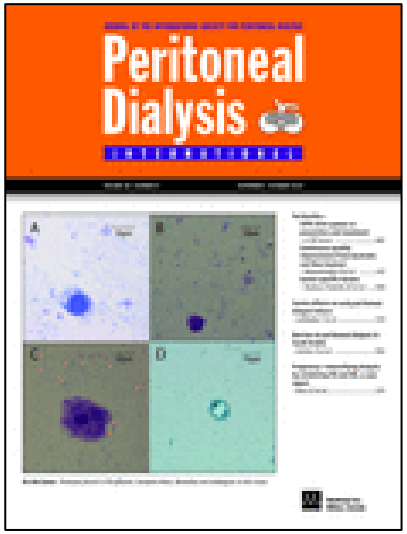
Free water transport

Osmotic conductance

ISPD PERITONITIS RECOMMENDATIONS: 2016 UPDATE ON PREVENTION AND TREATMENT

Philip Kam-Tao Li,[1] Cheuk Chun Szeto,[1] Beth Piraino,[2] Javier de Arteaga,[3] Stanley Fan,[4] Ana E. Figueiredo,[5] Douglas N. Fish,[6] Eric Goffin,[7] Yong-Lim Kim,[8] William Salzer,[9] Dirk G. Struijk,[10] Isaac Teitelbaum,[11] and David W. Johnson[12]

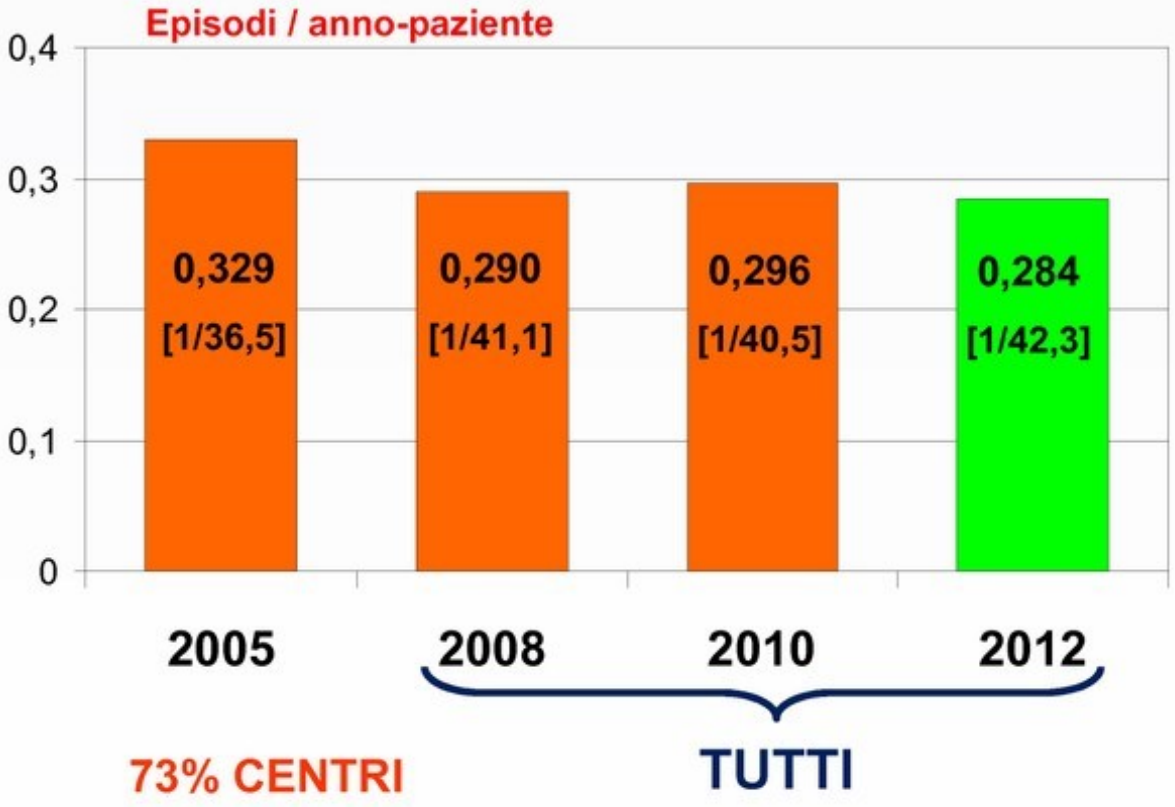
Perit Dial Int September-October 2016 36:481-508



CENSIMENTO GSDP 2012

PERITONITI

1.179 EPISODI IN 49.836 MESI-PZ



ISPD PERITONITIS RECOMMENDATIONS: 2016 UPDATE ON PREVENTION AND TREATMENT

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Table 2. Intraperitoneal Antibiotic Choices for Peritonitis

Gram Stain Results	Therapy: Typical Initial Agents	Examples: Dosing for CAPD, per Exchange, Once Daily[a]	Examples: Dosing for Automated PD Once Daily, Long Dwell[b]
Gram-positive	First-generation cephalosporin	Cefazolin 15 mg/kg	Cefazolin 20 mg/kg
		Vancomycin 15-30 mg/kg every 5-7 d; aim for trough > 15 µg/mL	Vancomycin loading dose of 30 mg/kg, then 15 mg/kg every 3-5 d; aim for trough > 15 µg/mL
Gram-negative	Third-generation cephalosporin or quinolone; aminoglycoside can be used if urine output < 100 mL/d	Ceftazadime 1,000-1,500 mg	Ceftazadime 1,000-1,500 mg
		Gentamicin/tobramycin 0.6 mg/kg	Gentamicin/tobramycin loading dose 1.5 mg/kg, then 0.5 mg/kg
Organisms not seen	Cover Gram-positive and -negative organisms		

Abbreviations: CAPD, continuous ambulatory peritoneal dialysis; ISPD, International Society for Peritoneal Dialysis; PD, peritoneal dialysis.

[a]Refer to Table 4, ISPD Guidelines/Recommendations, *Perit Dial Int*. 2010;30:393-423 for continuous CAPD dosing.

[b]Refer to Table 5, ISPD Guidelines/Recommendations, *Perit Dial Int*. 2010;30:393-423 for additional antibiotic dosing.

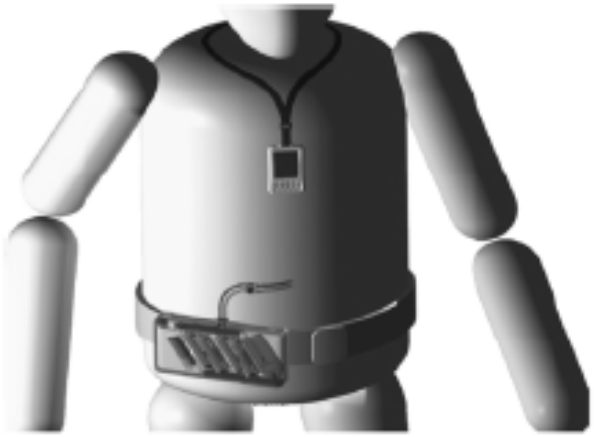
	Intermittent (1 exchange daily)	Continuous (all exchanges)
Aminoglycosides		
Amikacin	2 mg/kg daily (25	
Gentamicin	0.6 mg/kg daily (2	
Netilmicin	0.6 mg/kg daily (2	
Tobramycin	0.6 mg/kg daily (2	
Cephalosporins		
Cefazolin	15–20 mg/kg daily (26	
Cefepime	1,000 mg daily (262	263)
→ Cefoperazone	no data	55)
→ Cefotaxime	500–1,000 mg daily	
Ceftazidime	1,000–1,500 mg daily (2	
→ Ceftriaxone	1,000 mg daily (26	
Penicillins		
Penicillin G	no data	0)
Amoxicillin	no data	
Ampicillin	no data	
Ampicillin/Sulbactam	2 gm/1 gm every 12 hou	
→ Piperacillin/Tazobactam	no data	5)
Others		
Aztreonam	2 gm daily (242	)
Ciprofloxacin	no data	
→ Clindamycin	no data	
Daptomycin	no data	
Imipenem/Cilastatin	500 mg in alternate excha	
→ Ofloxacin	no data	
→ Polymyxin B	no data	
Quinupristin/Dalfopristin	25 mg/L in alternate excha	
→ Meropenem	1 gm daily (282	
Teicoplanin	15 mg/kg every 5 days	
Vancomycin	15–30 mg/kg every 5–7 d	)
Antifungals		
Fluconazole	IP 200 mg every 24 to 48 h	
→ Voriconazole	IP 2.5 mg/kg daily (	

TABLE 6
Systemic Antibiotic Dosing Recommendations for Treatment of Peritonitis

Drug	Dosing
Anti-bacterials	
Ciprofloxacin (237)	oral 250 mg BD[a]
Colistin (288)	IV 300 mg loading, then 150–200 mg daily[b]
Ertapenem (289)	IV 500 mg daily
Levofloxacin (239)	oral 250 mg daily
Linezolid (290–292)	IV or oral 600 mg BD
Moxifloxacin (293)	oral 400 mg daily
Rifampicin (294,295)	450 mg daily for BW <50 kg; 600 mg daily for BW ≥50 kg
Trimethoprim/ Sulfamethoxazole (252)	oral 160 mg / 800 mg BD
Anti-fungals	
Amphotericin (296)	IV test dose 1 mg; starting dose 0.1 mg/kg/day over 6 hours; increased to target dose 0.75–1.0 mg/kg/day over 4 days
Caspofungin (297,298)	IV 70 mg loading, then 50 mg daily
Fluconazole (299)	oral 200 mg loading, then 50–100 mg daily
Flucytosine (296)	oral 1 gm/day
Posaconazole (300)	IV 400 mg every 12 hours
Voriconazole (301–303)	oral 200 mg every 12 hours

BD = twice a day; IV = intravenous; BW = body weight.
[a] Ciprofloxacin 500 mg BD may be needed if residual glomerular filtration rate is above 5 mL/min.
[b] Expressed as colistin base activity (CBA).

Wearable artificial kidney for PD



Ronco C, and Fecondini L, Blood Purif 2007

HomeChoice Claria Sharesource

Sharesource

Internet cloud based
medical device
connectivity platform

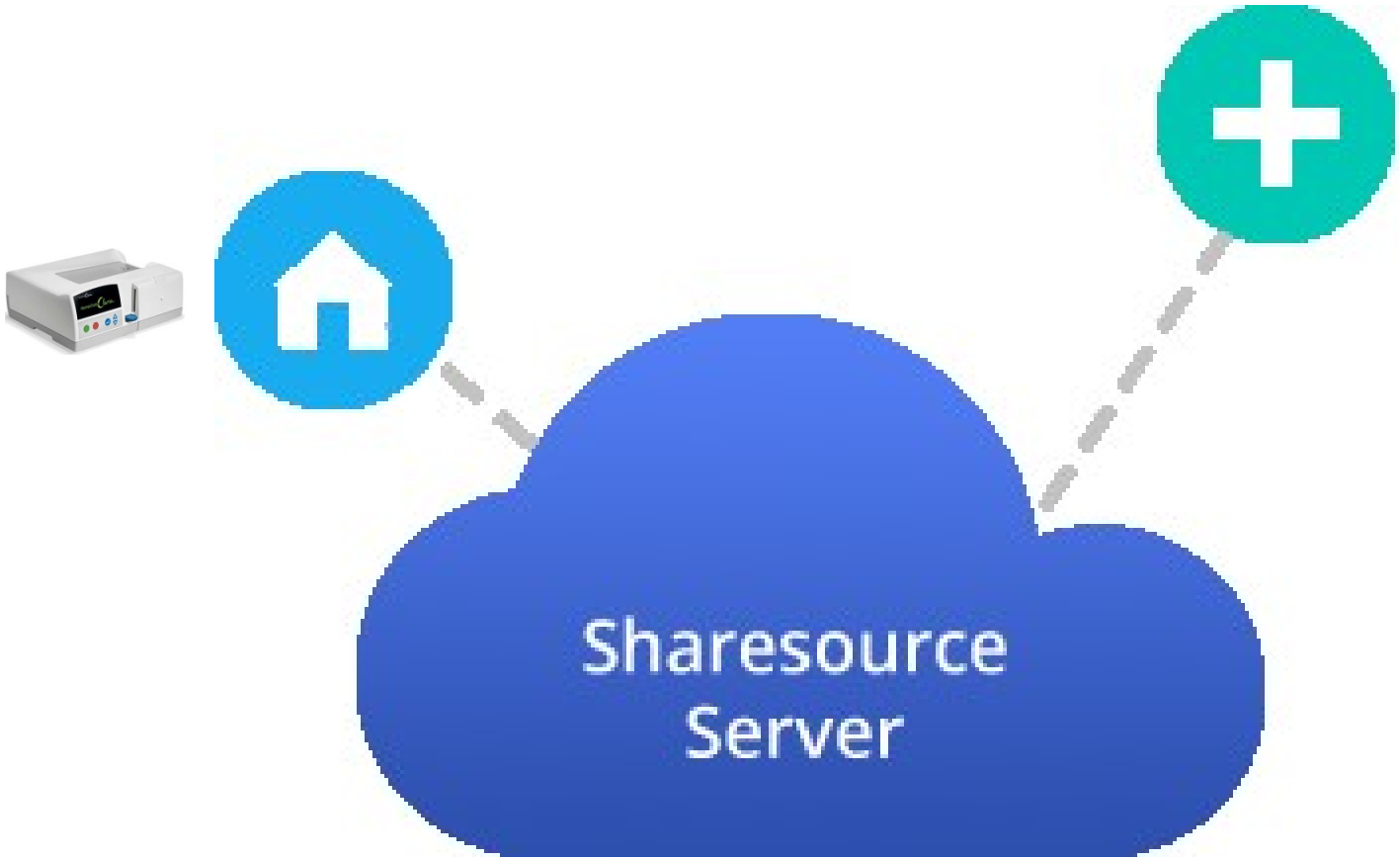
TELEMEDICINE AND REMOTE MONITORING: SUPPORTING THE PATIENT ON PERITONEAL DIALYSIS

Parameters of PD Exchanges to be Monitored

- Fill and drain volumes
- Fill and drain times
- Blood pressure
- Pulse
- Oxygen saturation
- Weight or bioimpedance
- Time/duration of treatment dwell
- Number of exchanges
- Prescription of dialysis
- Symptoms during therapy
- Alarms and patient response to alarms
- Activity during the day

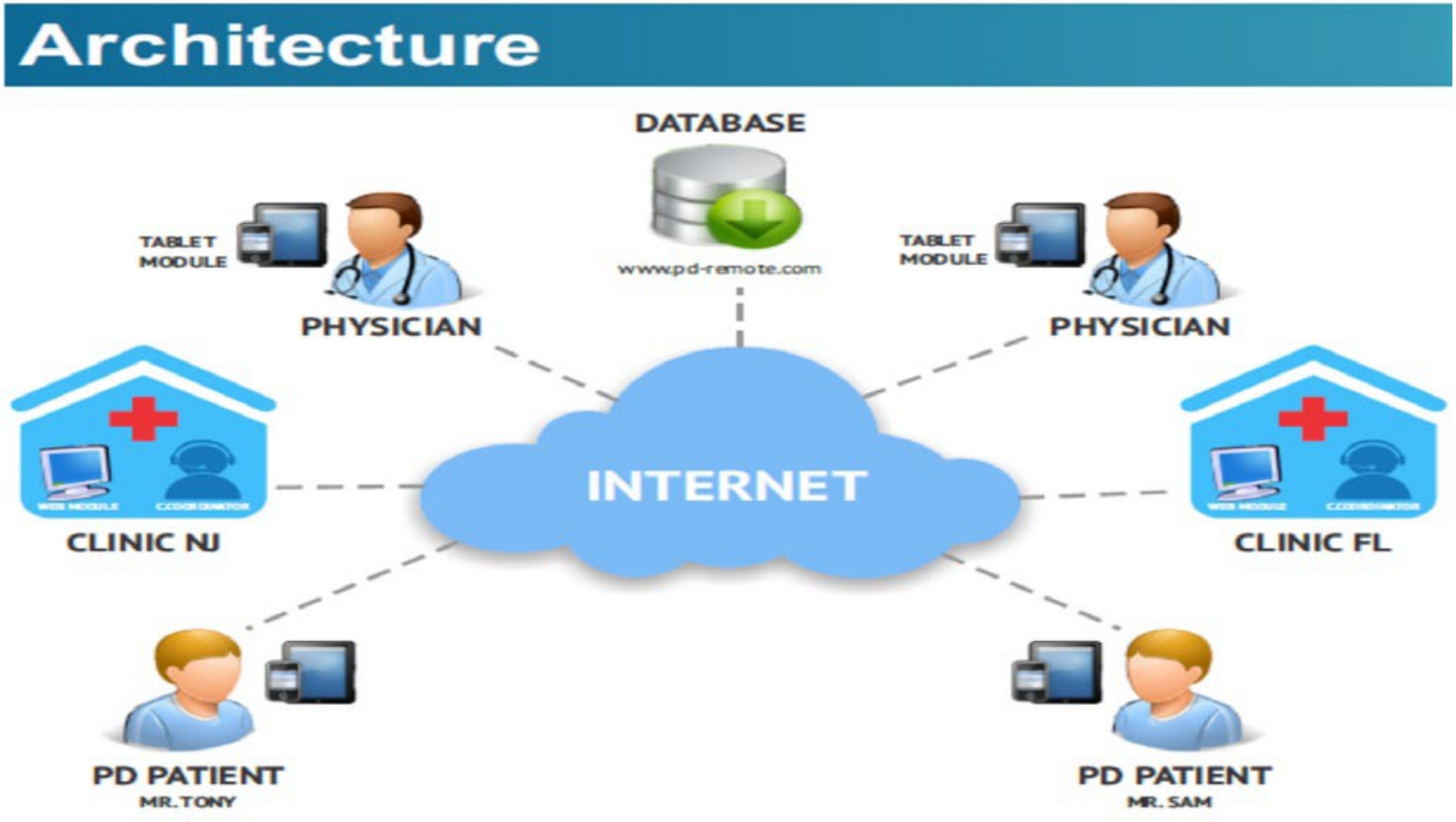
Perit Dial Int 2016; 36:362–366

HomeChoice Claria Sharesource



Internet cloud based medical device connectivity platform

TELEMEDICINE AND REMOTE MONITORING: SUPPORTING THE PATIENT ON PERITONEAL DIALYSIS



Perit Dial Int 2016; 36:362–366

HomeChoice Claria Sharesource

- **Remote patient monitoring** (access to patient hystory data, collection of new clinical data)
- **Clinical portal** (remote monitoring ot treatment data, remote update of dialysis programs, flagged alert system)
- **Customer Service Portal** (prescription management, order supplies online)
- **Patient Portal (**order online of supplies, online delivery calendar, reminders)

Sleep-safe Harmony

FRESENIUS
MEDICAL CARE

Sleep-safe Harmony

- Flex point technology
- Guided prescription (Adapted APD)
- Training support
- Automatic connection and barcode recognition of bag
- Patient card plus
- Plug & use

FRESENIUS MEDICAL CARE

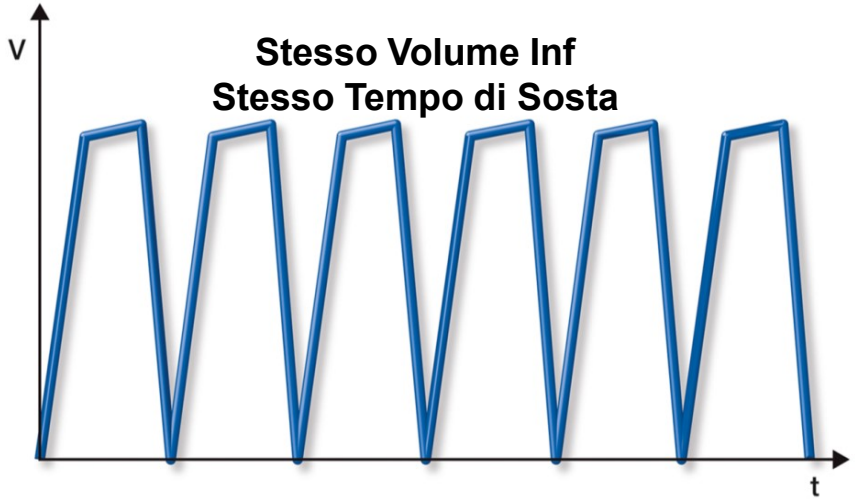
Adapted APD

- **Soste brevi per aumentare l'<u>UF</u>**
  (mantenedo alto il gradiente osmotico)
- **Bassi volumi per ridurre la PI**
  (rischio riassorbimento)

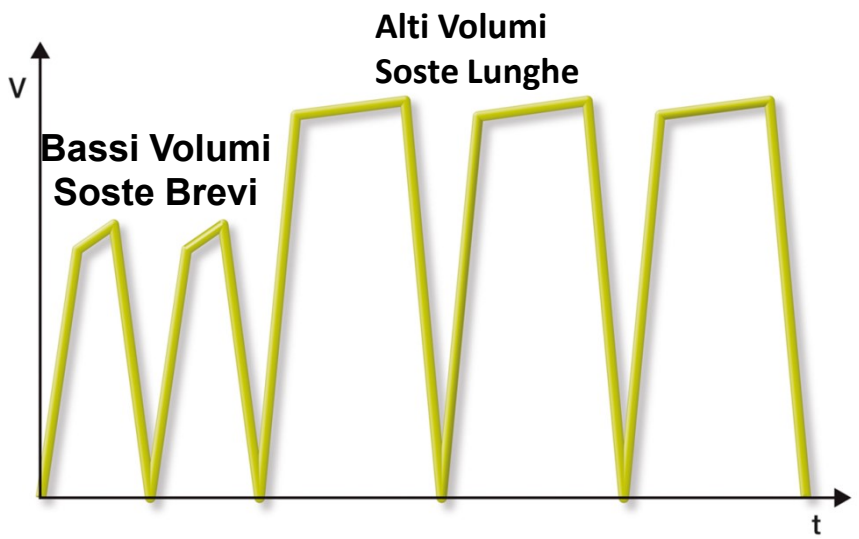
- **Soste lunghe per migliorare le <u>Clearance</u>**
  (creatinina, fosfati e medie molecole)
- **Migliorare le Clearance aumentando il volume di infusione**
  (maggior superficie)

Suddividere la prescrizione dialitica per ottimizzare <u>UF</u> & <u>Clearance</u>

Adapted APD



Conventional APD

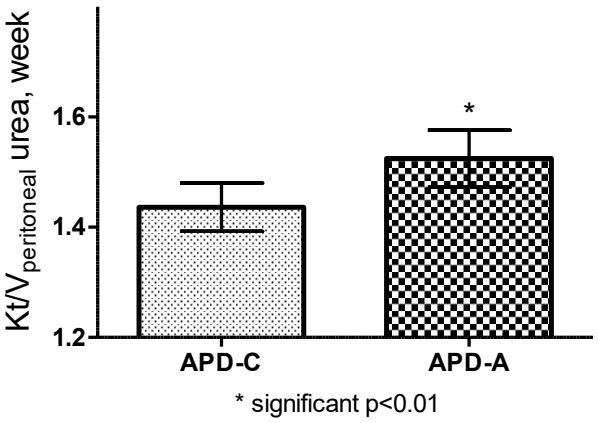


Adapted APD

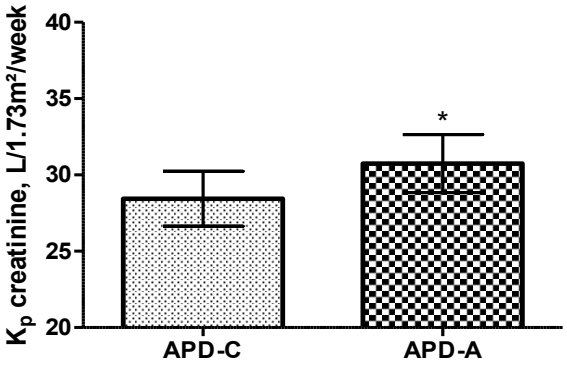
Impostazione personalizzata per ogni singolo ciclo

Stesso Volume Totale
Stessa Durata di Trattamento
Stessa Concentrazione di Glucosio

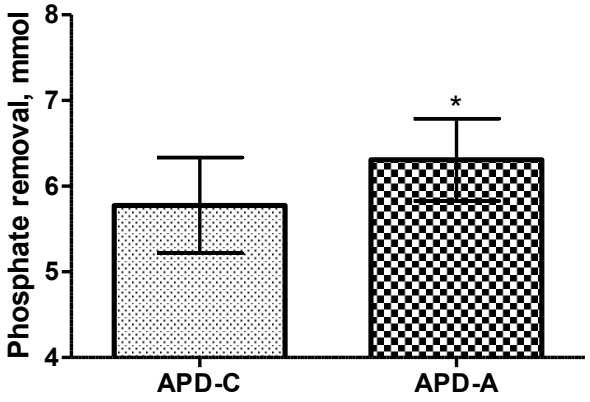
Significativo aumento delle Clearance (urea, creatinina, fosfati) con aAPD



* significant p<0.01

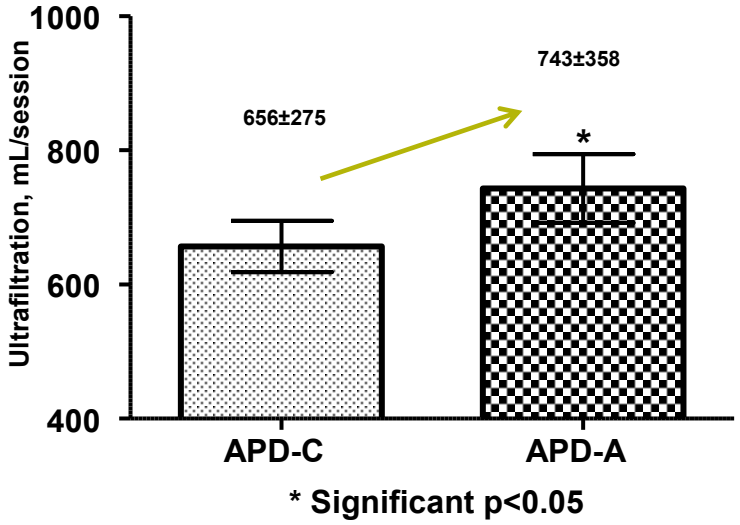


* Significant p<0.05

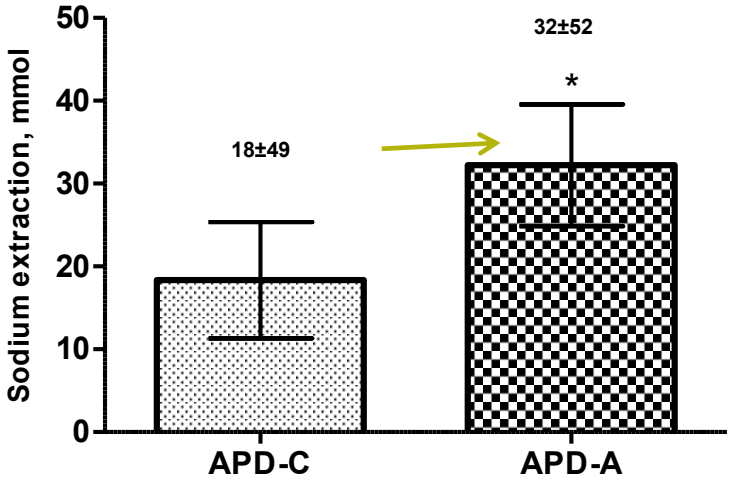


* Significant p<0.05

Maggior ultrafiltrazione e maggior rimozione di sodio con aAPD



*** Significant p<0.05**



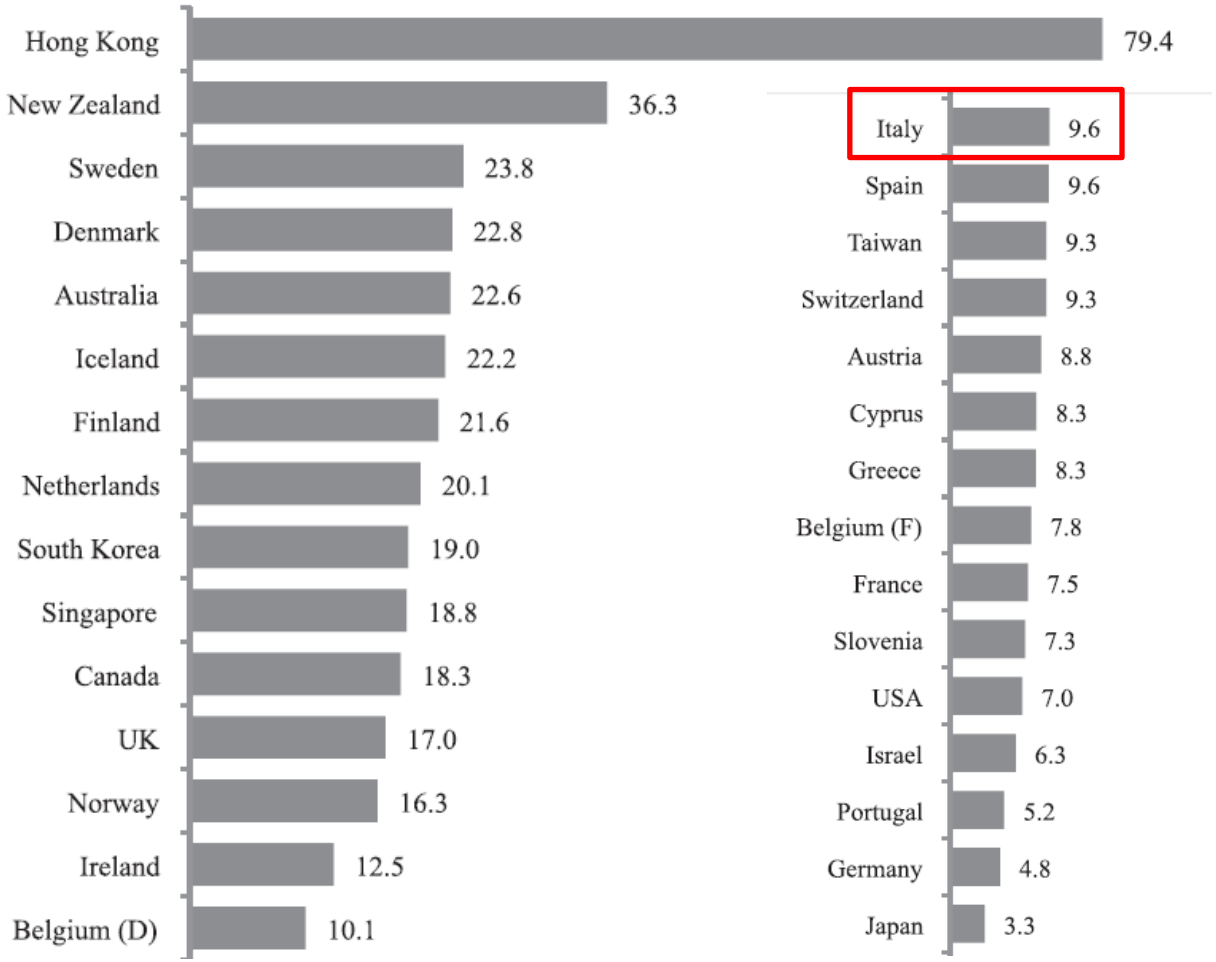
* Significant p<0.01

Fischbach M. et al, Perit Dial Int, 2011; 31(4):450-8

BANDA OSIRIS

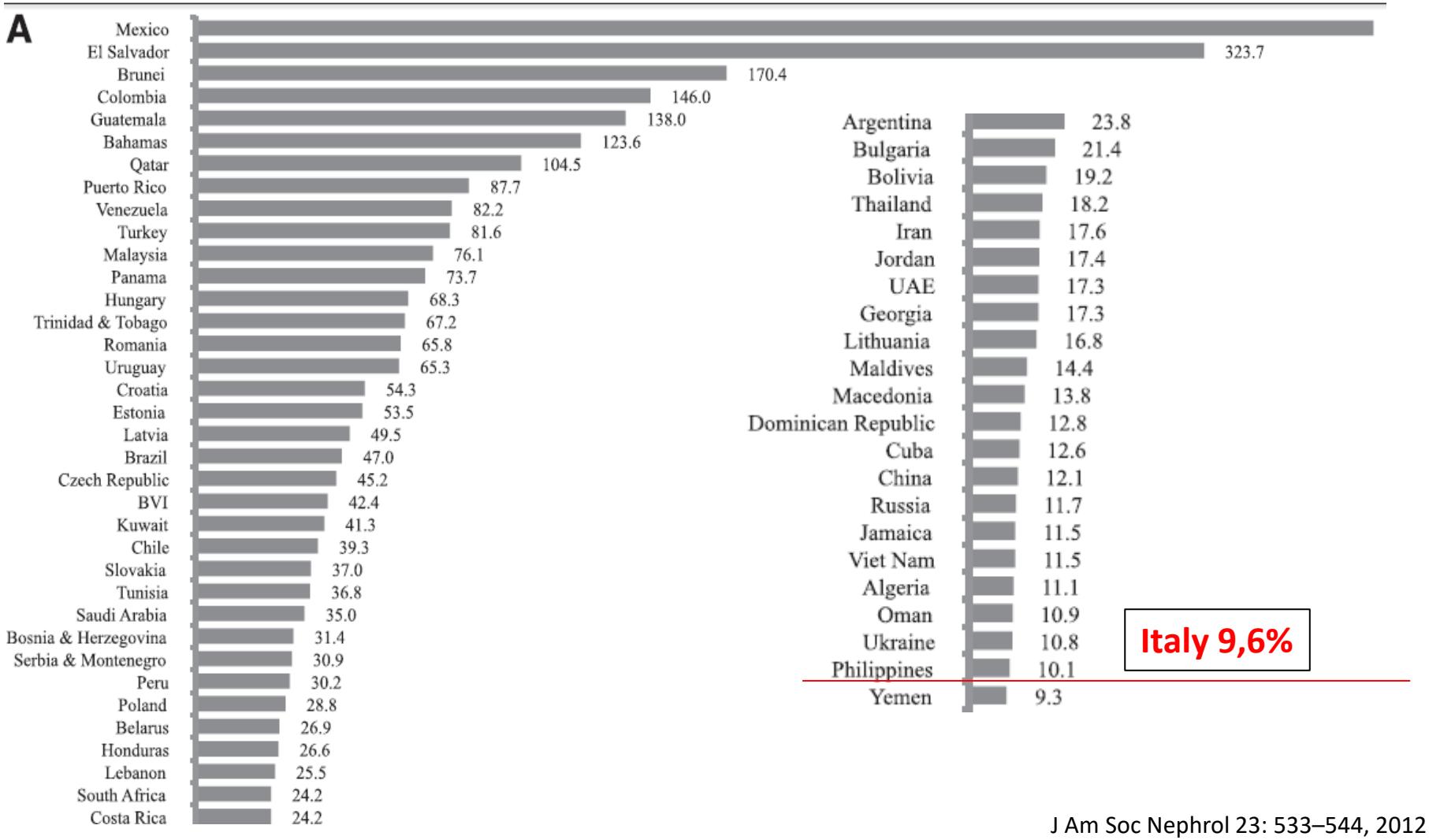
LE DOLENTI NOTE

PD prevalence in the developed countries …



J Am Soc Nephrol 23: 533–544, 2012

PD prevalence in developing countries



J Am Soc Nephrol 23: 533–544, 2012

GSDP
Gruppo di Studio di Dialisi Peritoneale
Società Italiana di Nefrologia

CENSIMENTO GSDP 2012

224 CENTRI - DATI 2012

Pazienti	DP	HD	%DP
INCIDENTI	1.433	4.700	23,4
PREVALENTI	4.299	20.844	17,1

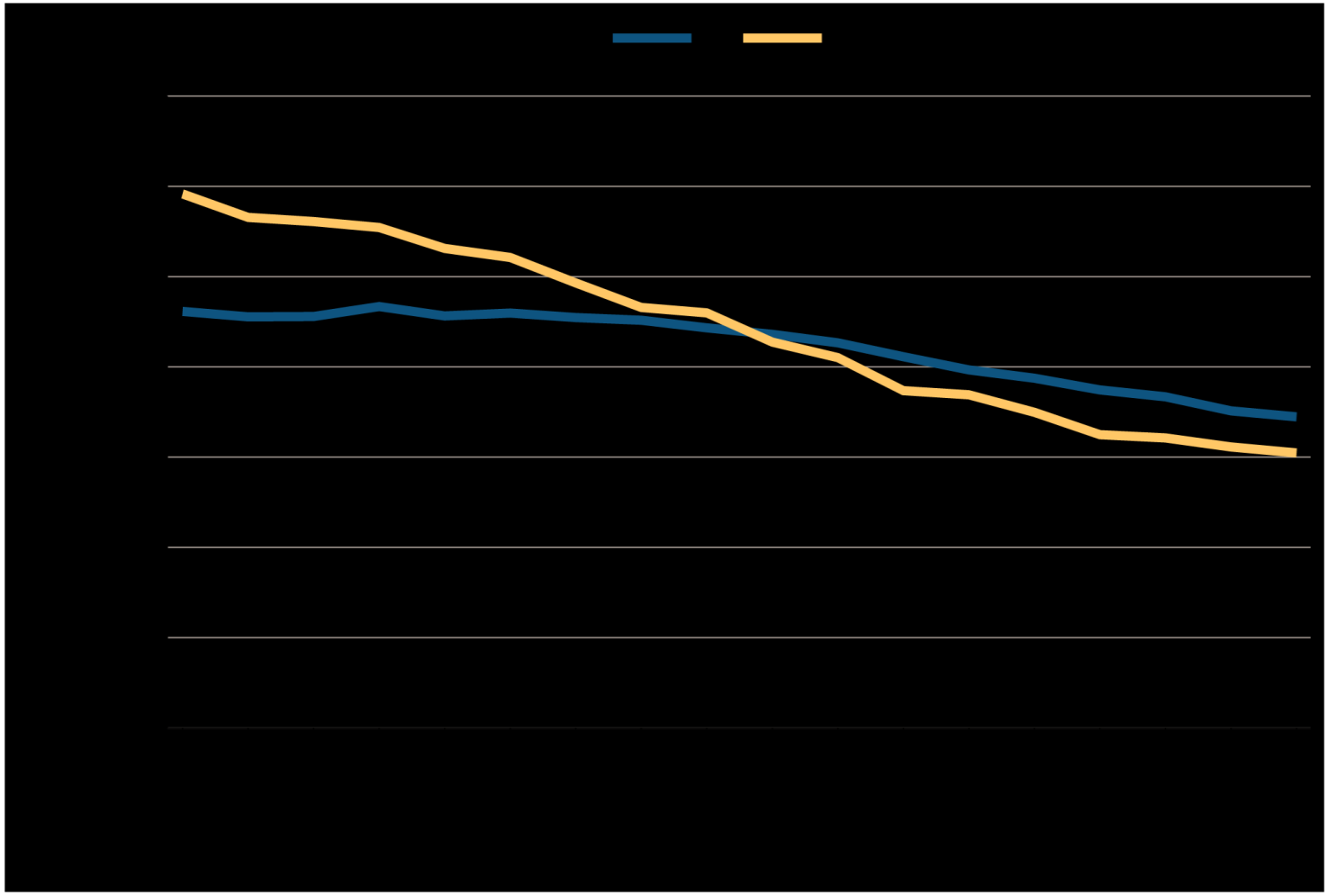
Frequenza relativa prevalenti PD

		2011	2012	2013
Campania				2,0
Sicilia	↑	5,0	5,2	5,1
Sardegna	↓	6,9	6,5	6,7
Puglia	↓	**7,4**	**6,8**	**6,3**
Lazio	↑	7,3	7,8	7,5
Molise	↓	9,4	7,3	7,0
Calabria	↑	7,6	7,9	9,0
Umbria			7,0	9,9
Italia	↑	**8,4**	**9,2**	**9,6**
Emilia	↑	9,3	9,8	9,6
Friuli	↓	10,5	9,8	9,8
Toscana				10,5
Lombardia	↓	11,7	10,9	10,5
Piemonte	↓	12,7	11,9	11,8
Liguria	↓	14,7	13,8	13,4
Veneto	↑	12,7	14,1	17,7
Trentino	↑	11,9	14,5	20,5

Mod. da RIDT

Trend in adjusted all-cause mortality (deaths/1,000 pt-years)

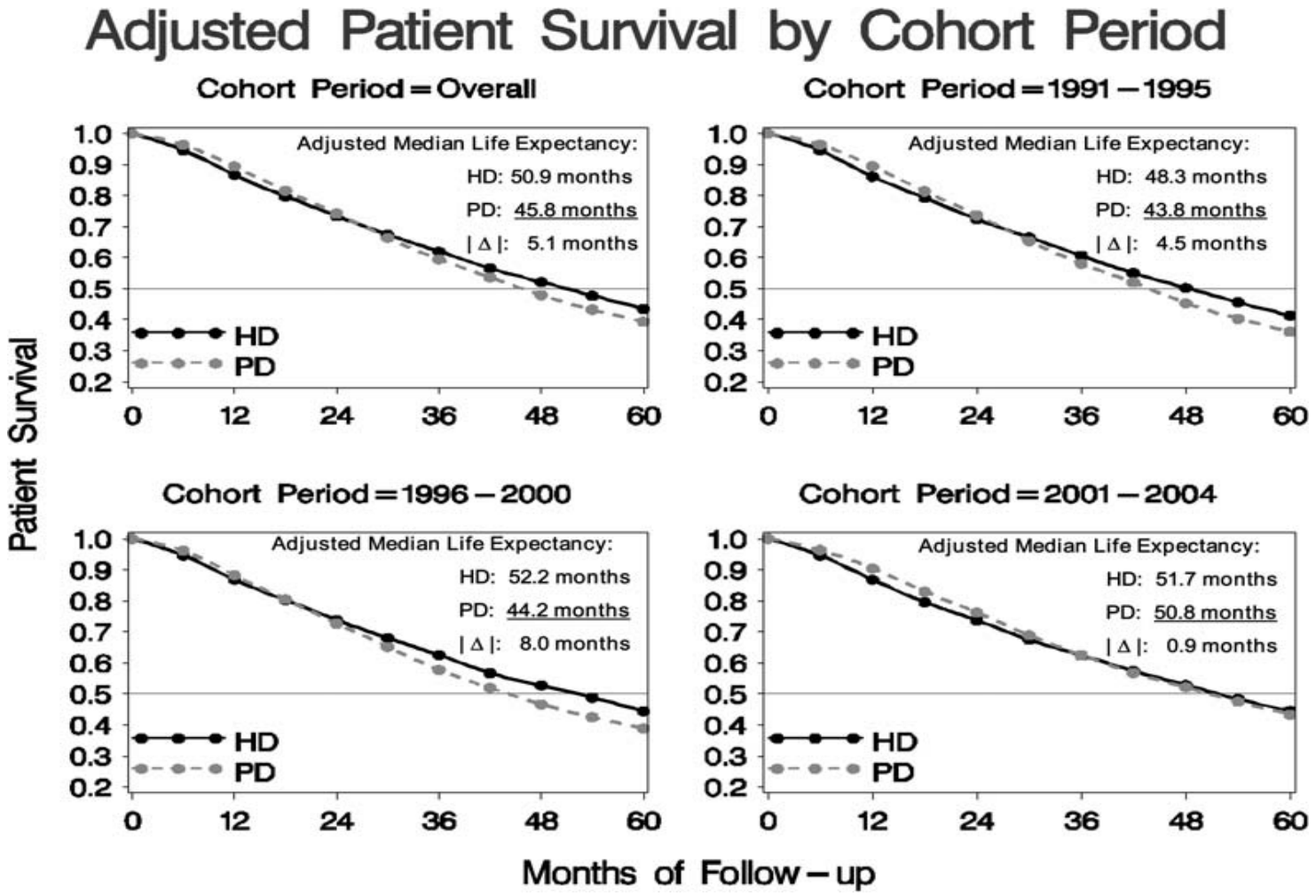
Hemodialysis versus Peritoneal Dialysis



USRDS 2015 Annual data Report

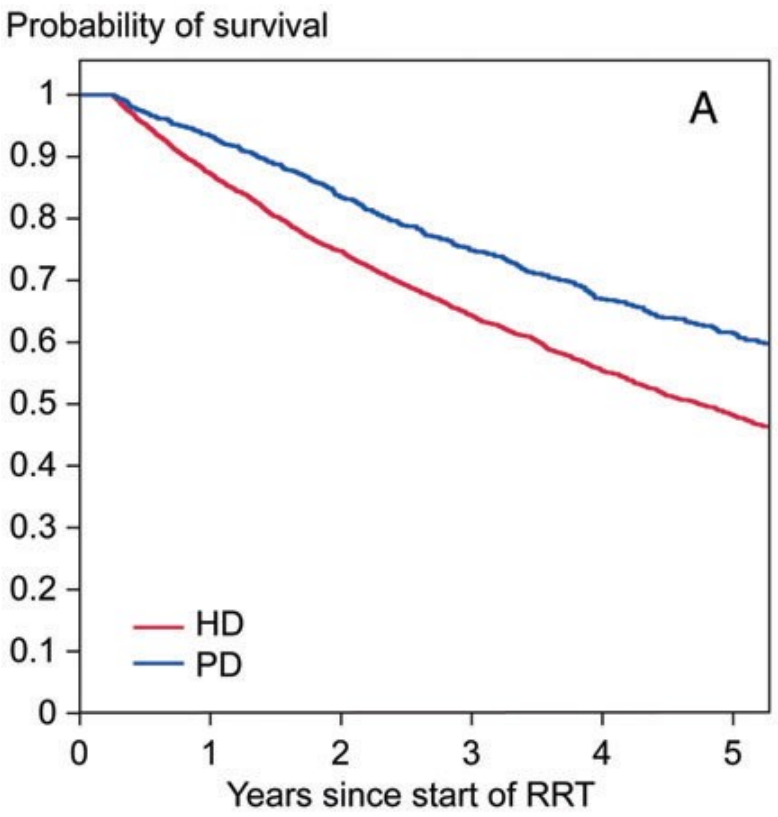
Hemodialysis and peritoneal dialysis are associated with similar outcomes for end-stage renal disease treatment in Canada

(46839 pts, 69,5% HD-30,5% PD)

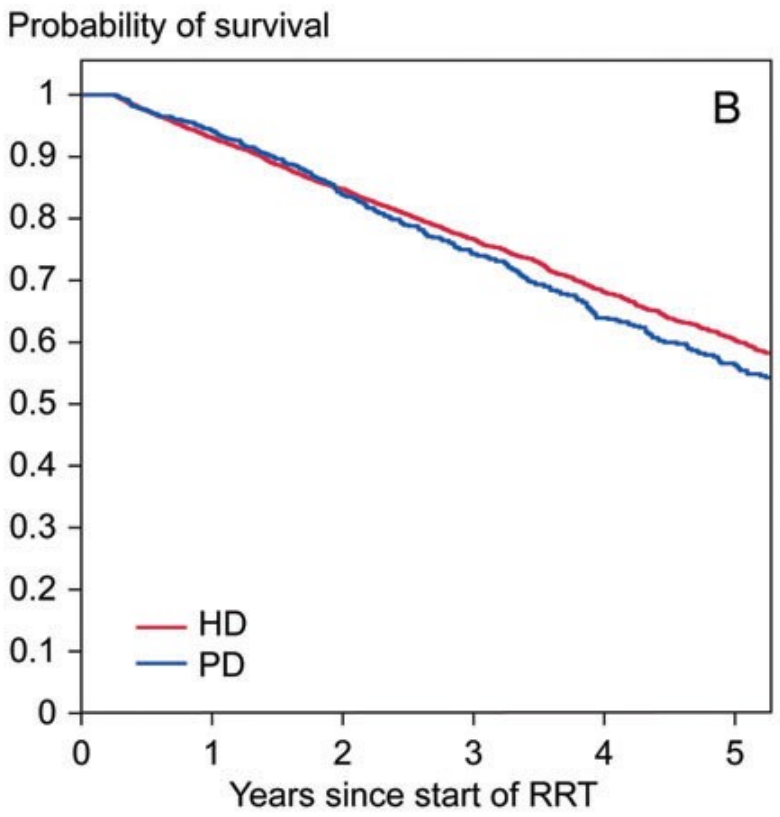


Nephrol Dial Transplant (2012) 27: 3568–3575

Modality of chronic renal replacement therapy and survival—a complete cohort from Finland, 2000–2009



unadjusted Kaplan–Meier curves



Adjusted Cox regression model

Nephrol Dial Transplant (2013) 28: 3072–3081

What do you consider to be the best initial dialysis treatment for a patient?

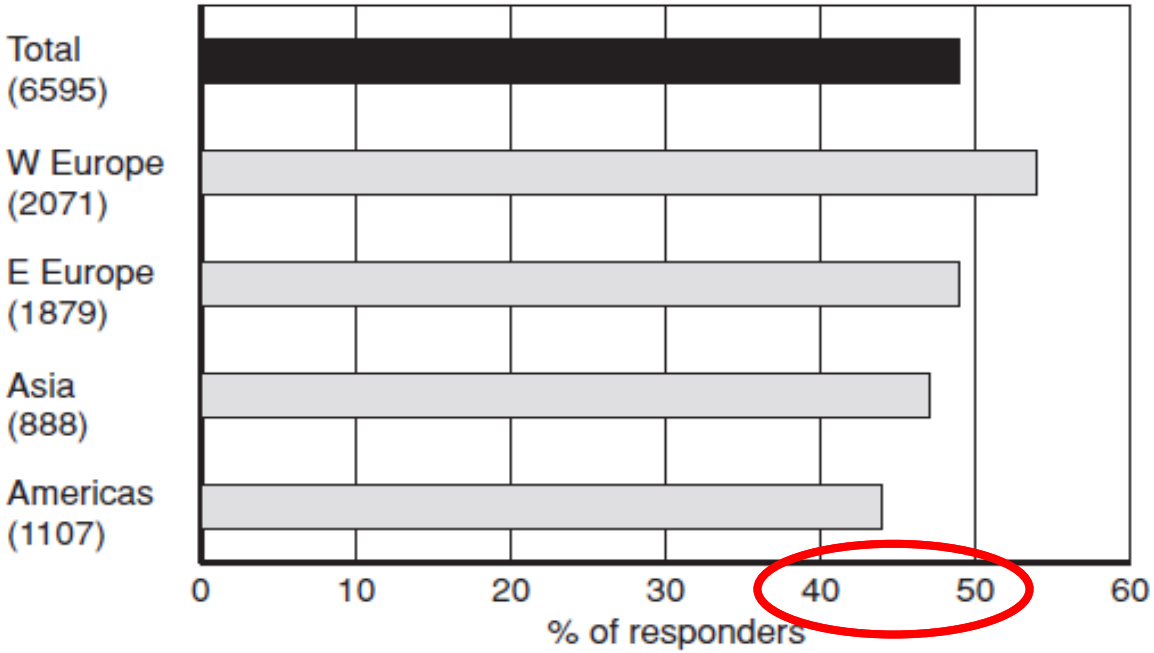


Fig. 1. Share of nephrology professionals who chose the answer 'CAPD/APD' in response to the question 'What do you consider to be the best initial dialysis treatment for a patient with planned start, today and in the near future?'

Ledebo I, NDT Plus (2008) 6: 403–408

What is the best long-term dialysis treatment?

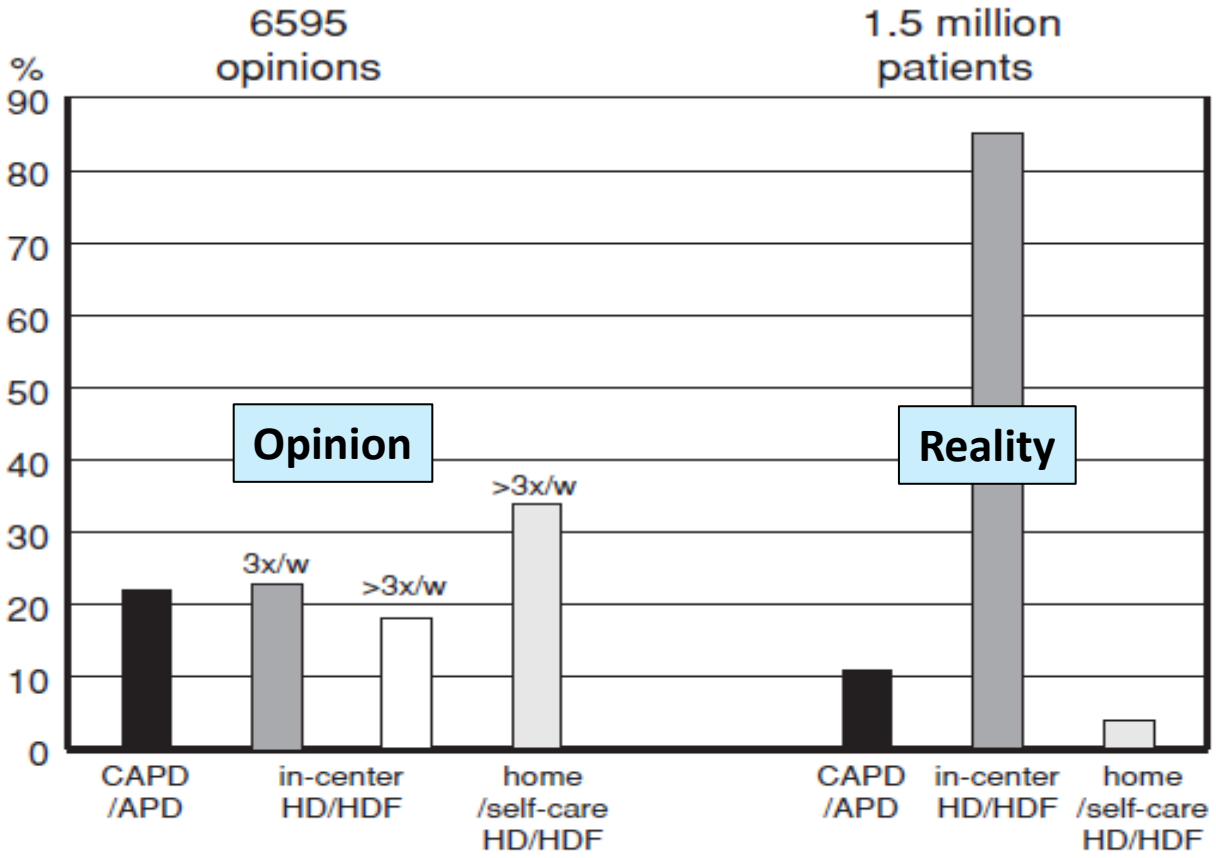


Fig. 5. What is the best long-term dialysis treatment? Opinion versus reality.

Ledebo I, NDT Plus (2008) 6: 403–408


CONGRESSO
IPOCONDRIACI
"No, non ti sei perso molto: quasi tutti sono stati a casa perché non si sentivano bene."

Grazie