Why PD?

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Wake Forest School of Medicine

Show of hands

- Dialysis
- Inpatient
- Outpatient
- Both
- PD program

Objectives

- Develop an appreciation for the need for PD as an option for dialysis patients
- Understand the current data regarding clinical outcomes in PD compared to HD
- Understand the current data regarding patient experience and quality of life
- Review some keys to success for an effective PD program

Outline

- PD as an option
- Clinical outcomes in PD
  - Mortality
  - Residual kidney function
- Patient Experience/Quality of Life
  - Employment
  - Special patient situations
- Keys to success

Why PD?
In short, we need options

Present Day

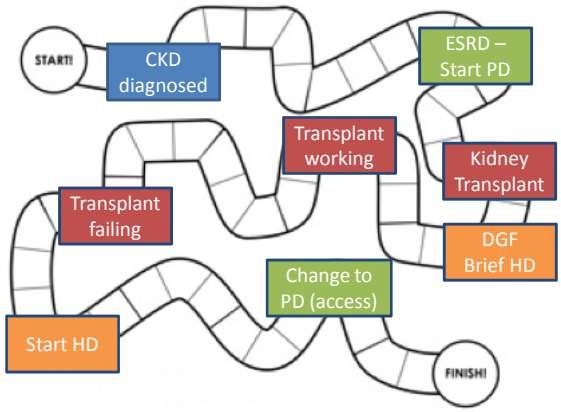
- In center hemodialysis
- Home hemodialysis
- Peritoneal dialysis
- Transplant

The future

- Implantable artificial kidney
- Transplant with immune tolerance
- Xenotransplantation
- Regenerative medicine

The Future of Kidney Care

The life of a kidney patient



Outline

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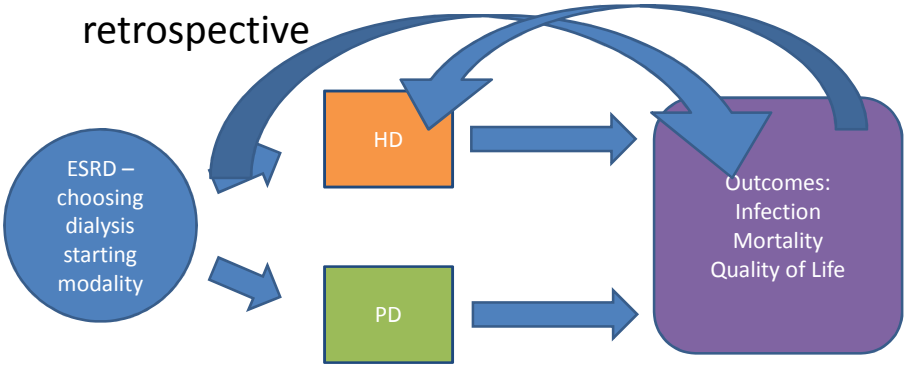
- Keys to success

Clinical outcomes

- Difficult to randomize patients to dialysis modality
- Many of the studies comparing PD to HD are retrospective



Mortality

- Challenges:
  - Comparing equal case-mix
    - More favorable clinical conditions for PD patients
      - Residual kidney function
      - Education/socioeconomics
      - Pre-dialysis care
  - Comparing patients on equal starting ground
    - HD patients starting with tunneled catheter are at a disadvantage

Mortality

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

Karen Yeates[1], Naisu Zhu[2], Edward Vonesh[3], Lilyanna Trpeski[4], Peter Blake[5] and Stanley Fenton[6]

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NDT Nephrology Dialysis Transplantation

Nephrol Dial Transplant (2012) 27: 3568–3575

HD and PD survival in Canada

- 35,265 prevalent RRT patients in 2007
- PD: 11.0%
- HD: 48.9%
- Reasons for low PD:
  - Historical survival studies
  - Changes in nephrology fellowship training – less comfortable with PD
  - Increasing prevalence of diabetic patients
  - Rising availability of HD units

Nephrol Dial Transplant (2012) 27: 3568–357

HD and PD survival in Canada

- Studied patients who started HD or PD over 3 periods:
  - 1991-1995
  - 1996-2000
  - 2001-2004
- Collected data from a Canadian health registry from 1991-2007 (17 years)
- Analyses:
  - Intent to Treat: modality at 90 days is assigned
  - As Treated: death attributed to modality at the time

Nephrol Dial Transplant (2012) 27: 3568–357

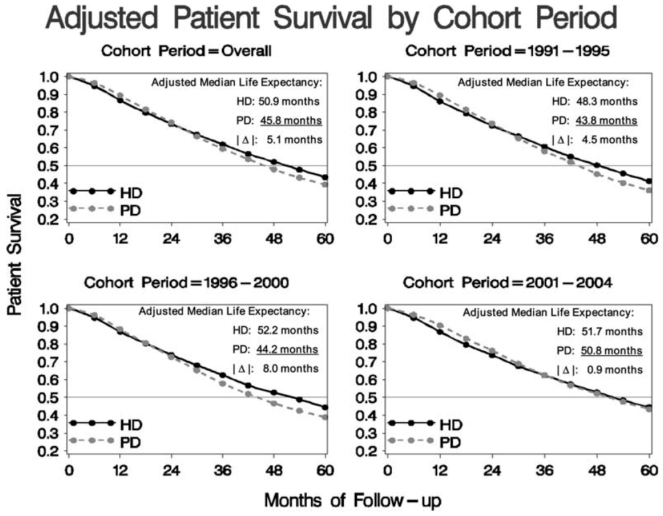
HD and PD survival in Canada

Table 2. Adjusted HRs (PD:HD) under a PHs model[a]

Group	HR ITT (95% CI)	HR AT (95% CI)
Overall (1991–2004)	1.08 (1.04–1.11)**	1.08 (1.05–1.11)**
1991–95	1.08 (1.02–1.15)*	1.10 (1.03–1.17)*
1996–2000	1.13 (1.07–1.20)**	1.15 (1.08–1.22)**
2001–04	0.99 (0.92–1.06)^{NS}	0.98 (0.92–1.05)^{NS}

Nephrol Dial Transplant (2012) 27: 3568–357

HD and PD survival in Canada



Nephrol Dial Transplant (2012) 27: 3568–357

HD and PD survival in Canada

Table 3. Adjusted HRs (PD:HD) under a PHs model results by type of patient and age[a]

Patient type	Age	HR ITT (95% CI)	HR AT (95% CI)
Non-DM	18–44	0.75 (0.57–0.99)*	0.70 (0.53–0.93)*
	45–64	0.90 (0.79–1.01)^{NS}	0.85 (0.75–0.96)*
	65+	1.05 (0.98–1.12)^{NS}	1.04 (0.97–1.11)^{NS}
DM	18–44	0.99 (0.81–1.23)^{NS}	0.91 (0.74–1.12)^{NS}
	45–64	1.11 (1.02–1.22)*	1.20 (1.09–1.31)**
	65+	1.19 (1.11–1.29)**	1.26 (1.16–1.36)**

[a]NS, not significant ($P > 0.05$).
*P-value < 0.05, **P-value < 0.001.

Nephrol Dial Transplant (2012) 27: 3568–357

HD and PD survival in Canada

- In this cohort, younger non-diabetics saw a survival advantage on PD
- In this cohort, older diabetics saw a survival advantage on HD
- May be a survival advantage to PD during first 1-2 years
- Improvement in PD survival in more recent patients may be due to improvements in care

Nephrol Dial Transplant (2012) 27: 3568–357

Mortality

Survival of propensity matched incident peritoneal and hemodialysis patients in a United States health care system

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[1]Division of Nephrology, Department of Internal Medicine, Southern California Permanente Medical Group, Los Angeles, California, USA; [2]Research and Evaluation, Southern California Permanente Medical Group, Pasadena, California, USA and [3]Department of Preventive Medicine, Feinberg School of Medicine, Northwestern University, Chicago, Illinois, USA

ISN kidney INTERNATIONAL
OFFICIAL JOURNAL OF THE INTERNATIONAL SOCIETY OF NEPHROLOGY

Kidney International (2014) 86, 1016–1022

Survival PD & HD in US

- Kaiser Permanente Southern California ESRD registry
- 11,301 patients initiated dialysis between 2001 and 2013
  - 10,298 HD; 1003 PD
- Included only patients registered in kidney database for 1 year prior to initiation
- Excluded patients using CVC in first 90 days

Kidney International (2014) 86, 1016–102

Survival PD & HD in US

- Matched each PD patient to an HD patient in the cohort based on:
  - Age
  - Sex
  - Race
  - Primary cause of ESRD
  - Year of initiation of dialysis
  - Charlson comorbidity index

Kidney International (2014) 86, 1016–102

Survival PD & HD in US

Table 2 | Baseline patient demographics for propensity score-matched PD and HD patients (1003 pairs)

	PD ($n = 1003$)	HD ($n = 1003$)	Standardized differences[a]
Mean age in years	57.4 ± 14.2	58.4 ± 13.6	0.08
Males (%)	543 (54.1)	543 (54.1)	0
Mean CCI	3.6 ± 1.6	3.5 ± 1.5	0.003
Race (%)			*0*
African American	143 (14.3)	143 (14.2)	
Hispanic	272 (27.1)	272 (27.1)	
Asian	142 (14.2)	142 (14.2)	
Other/unknown	135 (13.4)	135 (13.4)	
White	311 (31.0)	311 (31.0)	
Cause of ESRD (%)			*0*
Cystic kidney disease	55 (5.5)	55 (5.5)	
Glomerulonephritis	156 (15.6)	156 (15.6)	
Hypertension	184 (18.3)	184 (18.3)	
Diabetes mellitus	486 (48.5)	486 (48.5)	
Other	70 (7.0)	70 (7.0)	
Other urologic	13 (1.3)	13 (1.3)	
Unknown/missing	39 (3.9)	39 (3.9)	

Kidney International (2014) 86, 1016–102

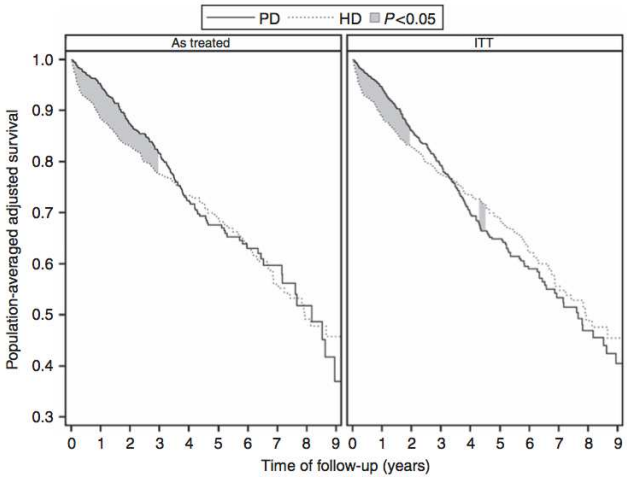
Survival PD & HD in US

Table 2 | Baseline patient demographics for propensity score-matched PD and HD patients (1003 pairs)

	PD ($n = 1003$)	HD ($n = 1003$)	Standardized differences[a]
Neighborhood family income per year (%)			*− 0.06*
$0-$25,000	34 (3.4)	31 (3.2)	
$25,001–$40,000	169 (17.1)	190 (19.4)	
$40,001–$60,000	295 (29.8)	294 (29.9)	
$60,001–$80,000	240 (24.2)	248 (25.3)	
>$80,000	252 (25.5)	219 (22.3)	
Neighborhood education level[b] (%)			*− 0.06*
<50% with HS education or higher	138 (13.9)	151 (15.4)	
50–75% with HS education or higher	315 (31.8)	325 (33.1)	
>75% with HS education or higher	537 (54.2)	506 (51.5)	

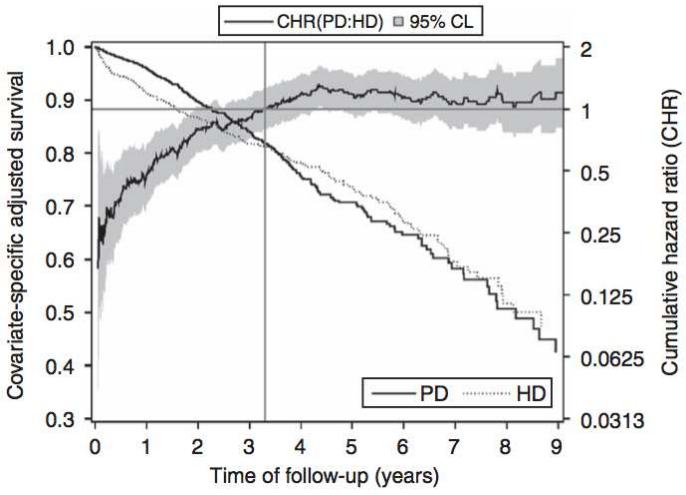
Kidney International (2014) 86, 1016–102

Survival PD & HD in US



Kidney International (2014) 86, 1016–102

Survival PD & HD in US



Kidney International (2014) 86, 1016–102

Survival PD & HD in US

- PD was associated with a survival advantage over the first 2-3 years
- After this time, no statistical difference in survival was seen
- Strengths of this study include a well matched population that received good pre-dialysis care and started with a long term access
- Early survival advantage may relate to preservation of residual kidney function in early years

Kidney International (2014) 86, 1016–102

Residual Kidney Function

Predictors of the rate of decline of residual renal function in incident dialysis patients

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Kidney International, Vol. 62 (2002), pp. 1046–1053

Predictors of RKF decline

- Netherlands (Netherlands Co-operative Study on the Adequacy of Dialysis phase 2 – NECOSAD-2).
- New ESRD patients from 32 dialysis units
- Initial GFR > 1 mL/min/1.73m2

Kidney International, Vol. 62 (2002), pp. 1046–

Predictors of RKF decline

- Residual kidney GFR = mean Creatinine and Urea clearances from 24 hour urine
- Hypotensive episodes on HD defined as hypotension requiring fluid resuscitation
- Data collected prospectively for 12 months

Kidney International, Vol. 62 (2002), pp. 1046–

Predictors of RKF decline

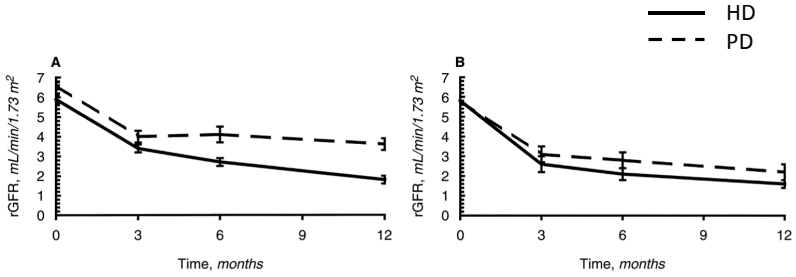
Table 1. Baseline characteristics

	HD	PD
Number	279	243
Age *years*	62 (14)	53 (15)[a]
Sex % *male*	59	63
Primary kidney disease %		
Diabetes	14	19
Renovascular	17	13
Glomerulonephritis	13	14
Other	56	54
Davies risk score %		
No comorbidity	45	55[b]
Intermediate comorbidity	44	39
Severe comorbidity	11	6
Use of antihypertensives %	74	87[a]
BMI kg/m^2	25.0 (4.3)	24.6 (3.8)
Systolic BP *mm Hg*	150 (24)	146 (23)
Diastolic BP *mm Hg*	82 (13)	86 (12)[a]
Plasma urea *mmol/L*	36.6 (10.4)	33.1 (8.9)[a]
Plasma creatinine *μmol/L*	767 (265)	763 (239)
Serum albumin *g/L*	37.4 (6.9)	37.9 (6.0)
rGFR $mL/min/1.73m^2$	5.9 (2.8)	6.4 (2.4)[d]
Urine production *L/day*	1.8 (0.7)	1.9 (0.6)[c]
Proteinuria *g/day*	4.0 (4.1)	4.1 (4.5)

Values are given as means (SD) or %.
[a] $P < 0.001$, [b] $P = 0.03$, [c] $P = 0.02$, [d] $P = 0.04$ for patients starting with peritoneal dialysis vs. patients starting with hemodialysis

Kidney International, Vol. 62 (2002), pp. 1046–

Predictors of RKF decline



Adjustments were made for baseline GFR, age, primary kidney disease, comorbidity, body mass index, systolic and diastolic blood pressure, use of antihypertensive drugs, drop- out, time of dropout, and reason of dropout (including change of treatment).

Kidney International, Vol. 62 (2002), pp. 1046–

Predictors of RKF decline

Table 3. Effect of hypotensive episodes on rGFR at three months in HD patients at different levels of adjustment

HD patients: hypotensive episodes	β ± SE[a]	*P*
Model 1; Adjusted for baseline GFR	−0.94 ± 0.32	0.003
Model 2; Adjusted for 1, and for age, sex, PKD, and comorbidity	−0.95 ± 0.32	0.004
Model 3; Adjusted for 1, 2, and for dialysis Kt/V_{urea} at 3 months	−0.76 ± 0.32	0.02

[a] β gives the effect in mL/min/1.73 m^2 on rGFR at 3 months

Kidney International, Vol. 62 (2002), pp. 1046–

Predictors of RKF decline

Table 4. Effect of dehydration on rGFR at three months in PD patients at different levels of adjustment

PD patients: underhydration	β ± SE[a]	*P*
Model 1; Adjusted for baseline GFR	−1.93 ± 0.64	0.003
Model 2; Adjusted for 1, and for age, sex, PKD, and comorbidity	−1.94 ± 0.64	0.003
Model 3; Adjusted for 1, 2, and for dialysis Kt/V_{urea} at 3 months	−1.84 ± 0.63	0.004

[a] β gives the effect in mL/min/1.73 m^2 on rGFR at 3 months

Kidney International, Vol. 62 (2002), pp. 1046–

RKF decline across studies

Reference	No. patients HD/PD	GFR baseline HD/PD	GFR 12 months HD/PD	Rate of decline in HD/PD	Difference in rate of decline
		mL/min		*%/month*	%[b]
Rottembourg et al [22]	25/25	4.3/4.4	2.1/3.8	6.0/1.2[a]	80
Cancarini et al [23]	75/86				
Lysaght et al [24]	57/58	5.0/4.5		5.8/2.9	50
Misra et al [26]	40/103	4.2/5.1		7.0/2.2	69
Lang et al [27]	30/15	7.5/7.4	3.8/6.0	5.8/1.8[a]	69
Present study	279/243	Unadjusted 5.9/6.4	1.9/3.5	9.4/5.0[a]	47
		Adjusted: 5.1/5.8	1.4/2.2	10.7/8.1[a]	24

Kidney International, Vol. 62 (2002), pp. 1046–

Avoiding a hemodialysis catheter

Hemodialysis Vascular Access Modifies the Association between Dialysis Modality and Survival

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J Am Soc Nephrol **22:** 1113–1121, 2011

Outline

- PD as an option
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  - Mortality
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- Patient Experience/Quality of Life
  - Employment
  - Special patient situations
- Keys to success

Employment

Depressed Mood, Usual Activity Level, and Continued Employment after Starting Dialysis

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CJASN
Clinical Journal of the American Society of Nephrology

Clin J Am Soc Nephrol 5: 2040–2045, 2010.

Mood and employment on dialysis

- Comprehensive Dialysis Study (CDS)
- Prospective cohort study sampling patients from 335 facilities in the U.S.
- 1643 patients interviewed by phone
- Mean time on dialysis = 4 months

Clin J Am Soc Nephrol 5: 2040–2045, 201

Mood and employment on dialysis

- Asked the following questions:
  - Were you working for pay at any time the year before you started dialysis?
  - Are you now working for pay? If yes, what type of work?
  - Are you receiving disability benefits?
- Education level
- Depression screening (PHQ-2) (higher = depressed)
- Human activity profile (HAP) (higher = more active)

Clin J Am Soc Nephrol 5: 2040–2045, 201

Mood and employment on dialysis

Table 2. Employment status approximately 4 months after dialysis start of CDS participants who worked in the year before dialysis (n = 585)

Parameter	Working Now Full or Part Time (n = 191)	Not Working Now (n = 394)	P
Age (years; mean ± SD)	53.5 ± 13.4	53.0 ± 13.5	0.69
Male (%)	64.4	58.1	0.19
Black (%)	27.8	38.8	0.04
Education (%)			0.001
high school or less	35.3	55.6	
at least some college	64.7	44.4	
EGH insurance (%)	68.1	31.2	<0.0001
Receiving disability income (%)	14.1	50.9	<0.0001
Diabetes (%)	39.8	48.0	0.11
Not able to ambulate or transfer (%)	0.5	1.0	0.56
COPD (%)	3.7	4.1	0.82
No. of cardiovascular conditions (mean ± SD)	0.6 ± 1.0	0.7 ± 0.9	0.27
Hemoglobin (g/dl; mean ± SD)	10.3 ± 1.8	9.9 ± 1.9	0.03
Serum albumin (g/dl; mean ± SD)	3.4 ± 0.6	3.1 ± 0.8	0.0003
HD (%)	81.1	94.1	<0.0001
PHQ-2 score (mean ± SD)	1.0 ± 1.5	1.8 ± 1.9	<0.0001
AAS (HAP; mean ± SD)	60.2 ± 14.8	46.1 ± 18.6	<0.0001

Clin J Am Soc Nephrol 5: 2040–2045, 201

Mood and employment on dialysis

Table 3. Predictors of continued employment among ambulatory CDS participants who worked in the year before dialysis (n = 564)

Parameter	OR	95% CI	P
Age	1.01	0.99 to 1.03	0.25
Male	1.36	0.85 to 2.15	0.20
Black	0.91	0.54 to 1.54	0.72
At least some college	1.37	0.84 to 2.24	0.20
EGH insurance	3.25	2.10 to 5.03	<0.0001
Receiving disability income	0.26	0.14 to 0.47	<0.0001
Diabetes	0.78	0.48 to 1.27	0.32
COPD	2.19	0.83 to 5.83	0.12
No. of cardiovascular conditions	1.07	0.83 to 1.37	0.60
HD	0.39	0.19 to 0.81	0.01
PHQ-2 score	0.87	0.74 to 1.01	0.06
AAS (HAP)	1.04	1.02 to 1.05	<0.0001

Clin J Am Soc Nephrol 5: 2040–2045, 201

Employment

Employment in the patient with chronic kidney disease related to renal replacement therapy

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nefrología Nefrologia 2012;32(4):439-45

Employment and RRT

- 8 hospitals in Spain
- 243 patients on RRT (HD, PD, transplant)
- Surveyed between 2007-2009

Nefrologia 2012;32(4):439-45

Employment and RRT

Table 1. Patient occupation by treatment type

	Total	Occupational situation		*P*-value
		No	Yes	
16-64 years of age	243 (100%)	162 (66.7%)	81 (33.3%)	
Sex				0.006[a]
- Male	147 (100%)	88 (59.9%)	59 (40.1%)	
- Female	96 (100%)	74 (77.1%)	22 (22.9%)	
Age (years)				
- Median (range)	49 (20-64)	51 (20-64)	44 (23-64)	
- Mean (SD)	47.6 (10.6)	49.6 (10.1)	43.5 (10.5)	< 0.001[b]
Time on treatment (years)				
- Median (range)	3.0 (0-32)	3.0 (0-32)	3.0 (0-27)	
- Mean (SD)	6.87 (8.02)	7.89 (8.77)	4.84 (5.78)	0.001[b]
Modality of RRT				0.012[a]
- Haemodialysis	83 (100%)	65 (78.3%)	18 (21.7%)	
- Transplant	82 (100%)	50 (61.0%)	32 (39.0%)	
- Continuous Ambulatory PD	32 (100%)	23 (71.9%)	9 (28.1%)	
- Automated PD	46 (100%)	24 (52.2%)	22 (47.8%)	

Nefrologia 2012;32(4):439-45

Employment and RRT

Table 2. Probability of employment

	Univariate model			Multivariate model		
	OR	95% CI	P-value	OR	95% CI	P-value
Sex			0.006			0.021
- Male	(Baseline)			(Baseline)		
- Female	0.443	(0.249-0.791)		0.478	(0.256-0.896)	
Age	0.945	(0.920-0.971)	<0.001	0.944	(0.918-0.971)	<0.001
Time on treatment	0.946	(0.910-0.985)	0.006	0.946	(0.904-0.990)	0.017
Modality			0.014			0.022
- Haemodialysis	(Baseline)			(Baseline)		
- Transplant	2.311	(1.165-4.585)	0.017	2.481	(1.185-5.194)	0.016
- Continuous ambulatory PD	1.413	(0.557-3.584)	0.467	1.155	(0.421-3.165)	0.780
- Automated PD	3.310	(1.519-7.215)	0.003	2.964	(1.269-6.925)	0.012

Multivariate model controlled for: sex, age, time of treatment, and modality of dialysis

Nefrologia 2012;32(4):439-45

Employment and RRT

- Actively employed patients usually opt for APD
- Even transplant patients in this study were less active in the workplace than APD patients
- Regulations expecting transplant patients to gain employment may not take into account the challenges they face
  - Looking for a job after several years of incapacity

Nefrologia 2012;32(4):439-45

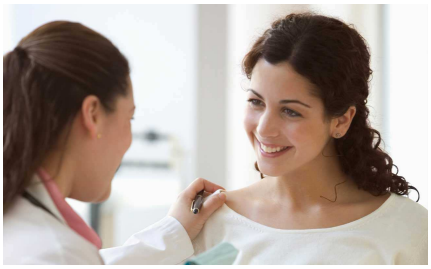
Special patient situations*

- RS, a 51 year old who works as a gas miner in Minnesota

*Internet photos: not real patients

Special patient situations*

- SD, a 42 year old with developmental delay, told she had no options



*Internet photos: not real patients

Special patient situations*

- AS, a 62 year old veteran hoping to retire and travel via RV

*Internet photos: not real patients

Special patient situations*

- RL, a 72 year old grandfather with advanced heart disease/CHF and hypotension whose resting blood pressure is 85/40.

*Internet photos: not real patients

Outline

- PD as an option
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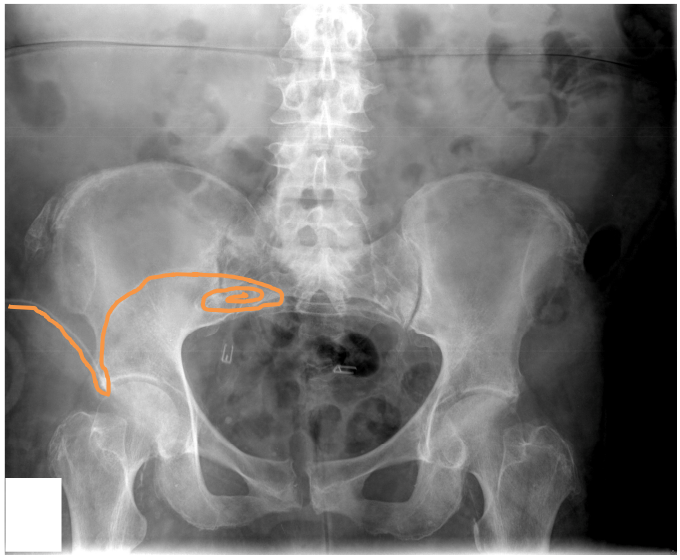
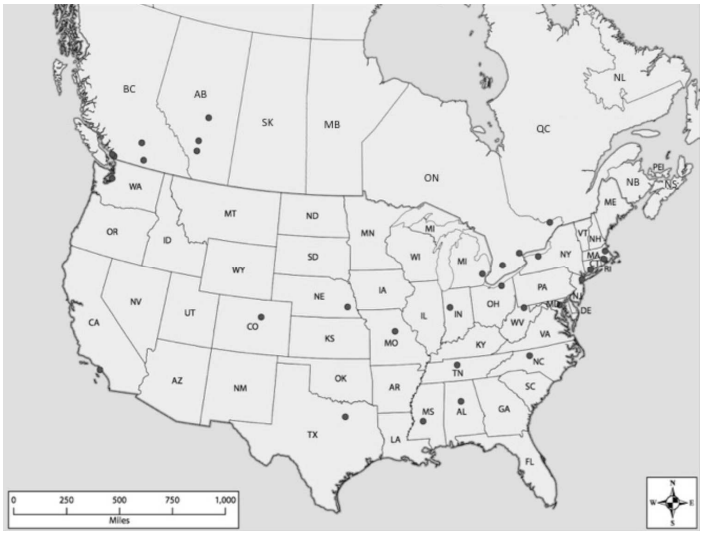
- Keys to success

Catheter placement



ISPD- North American Conference



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ISPD- NAC
Catheter insertion technique survey

- 82% of 51 centers responded
- Placement techniques:
  - 71% laparoscopic
  - 62% open surgical dissection
  - 10% blind insertion via trocar
  - 29% blind insertion via Seldinger technique
  - 80% had three such options available

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ISPD- NAC
Catheter insertion technique survey

- Catheter exit types available:
  - 36% buried catheters
  - 43% upper abdominal catheters
  - 41% presternal
- 86% of centers had current quality control in place

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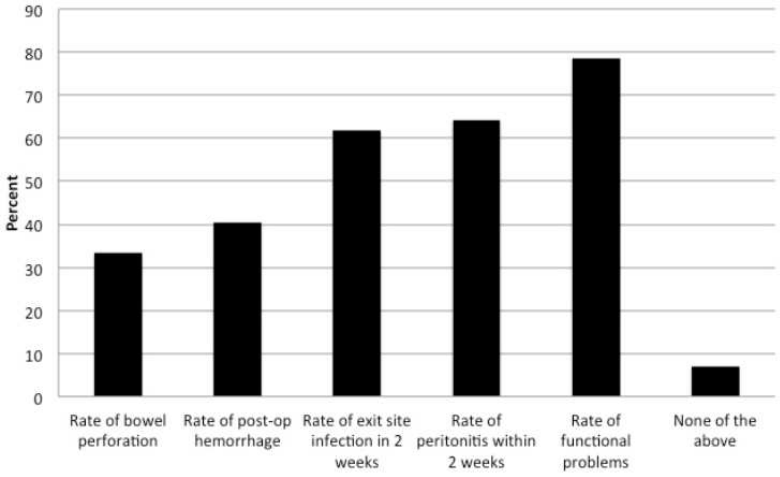
ISPD- NAC
Catheter insertion technique survey



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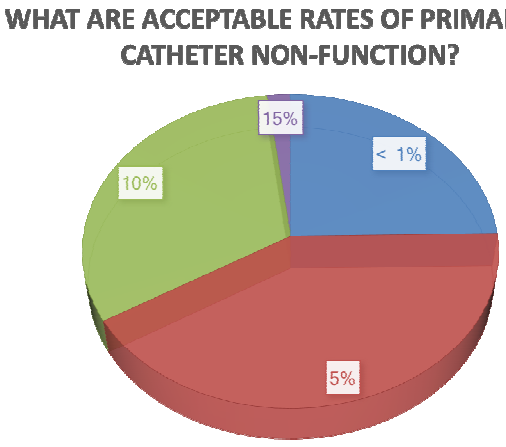
ISPD- NAC
Catheter insertion technique survey



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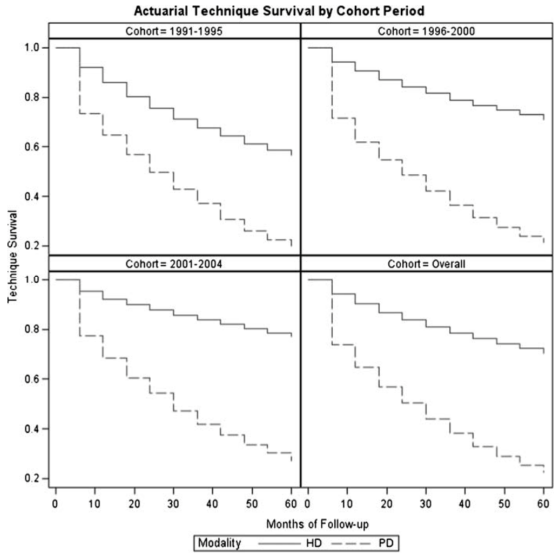
ISPD-NAC

- Currently enrolling for a prospective study of catheter placement and outcomes
- Hopes that this will inform guidelines to improve care across health systems

Importance of staff and experience



Nephrol Dial Transplant (2012) 27: 3568–357

Importance of staff and experience

Effect of renal center characteristics on mortality and technique failure on peritoneal dialysis

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Kidney International, Vol. 60 (2001), pp. 1517–1524

Effect of renal center characteristics on PD

- Data from Canadian Organ Replacement Register (CORR)
- All patients beginning therapy from 1981-1997

Kidney International, Vol. 60 (2001), pp. 1517–

Effect of renal center characteristics on PD

Table 4. Rate ratios based on 1990–97 experience and adjusted for comorbidity

Outcome	Characteristic	1981–97 Covariate-adjusted RR	1990–97 Covariate-adjusted RR	1990–97 Covariate- and comorbidity-adjusted RR	95% CI
Mortality	Cumulative number of PD patients treated				
	≤99	1	1	1	—
	100–199	0.95	0.81	0.78	0.67–0.91
	200–299	0.87	0.73	0.71	0.60–0.84
	300–399	0.85	0.69	0.69	0.57–0.83
	400–499	0.80	0.66	0.63	0.51–0.78
	≥500	0.71	0.54	0.51	0.41–0.64
Technique failure	Percentage of patients initiating dialysis on PD				
	≤29%	1.97	1.67	1.67	1.34–2.07
	30–39%	1.70	1.65	1.65	1.38–1.98
	40–49%	1.71	1.59	1.59	1.35–1.88
	50–59%	1.44	1.30	1.30	1.11–1.52
	≥60%	1	1	1	—

Kidney International, Vol. 60 (2001), pp. 1517–

Why PD?

We need options!

You never know when PD will make the journey through the life of a kidney patient more bearable

Your enthusiasm and expertise can make it happen

End

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