

Peritoneal Dialysis why to choose in 21st Century



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Grand Round KMC



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Objectives

- ESRD statistics and treatment options
- Basic principles of peritoneal dialysis
- Historical perspective of PD
- Advantages and disadvantages of PD
- Pearls for clinicians

*ESRD – end stage renal disease, *PD – peritoneal dialysis



Treatment Options For the Patient with ESRD (Renal Replacement Therapy)

1. In-center (outpatient) hemodialysis 3/week
2. Peritoneal Dialysis
3. Kidney transplant from deceased or living donor
4. Home hemodialysis 4-7/week
5. Not accepting any form of renal replacement therapy



What is Peritoneal dialysis?

Form of renal replacement therapy at home which involves use of PD catheter and specially manufactured solutions (dialysate).

Fluid get infused to peritoneal cavity, dwells, exchange electrolytes, absorbs toxins, get drained



Manual exchanges



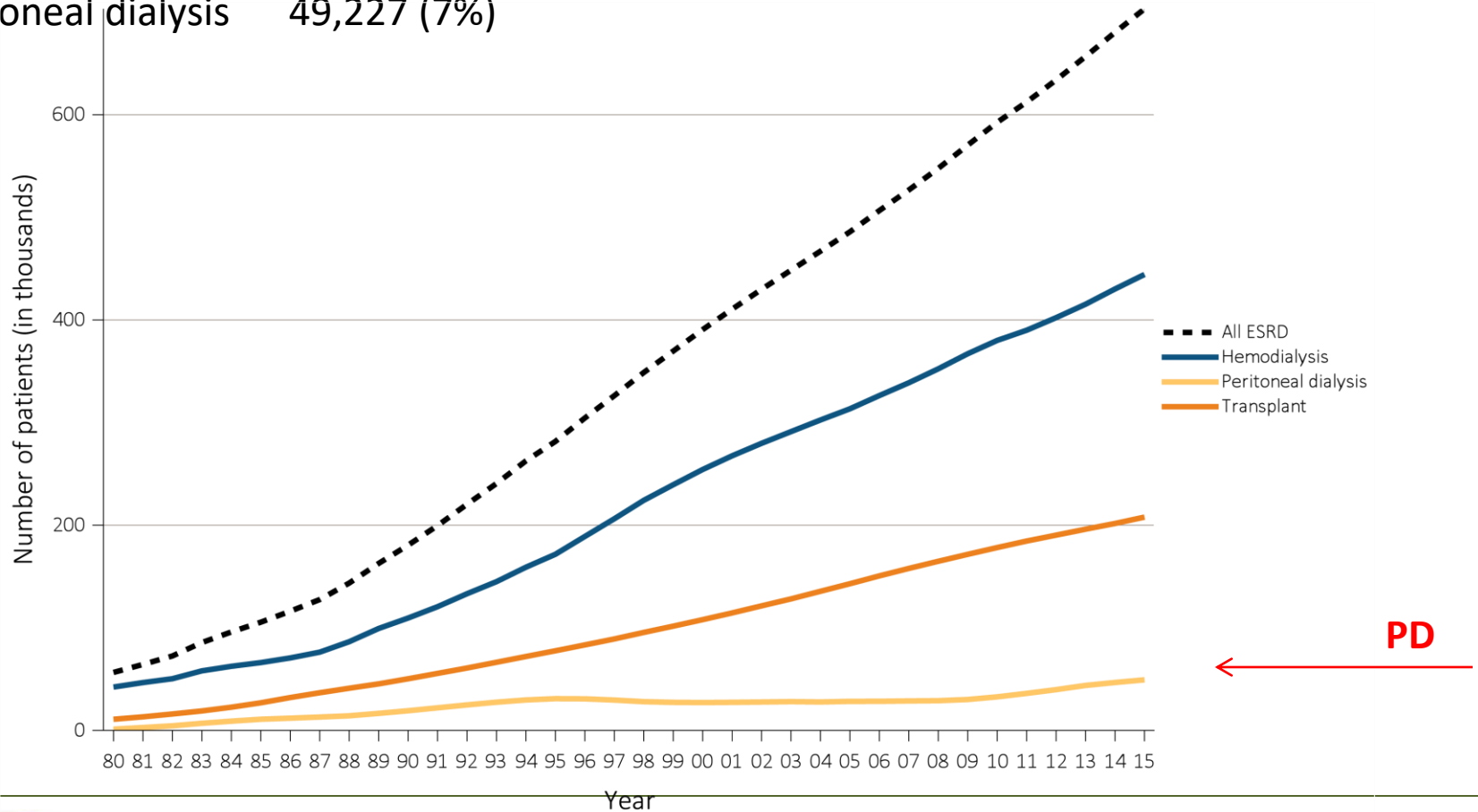
Automated, use of cycler device



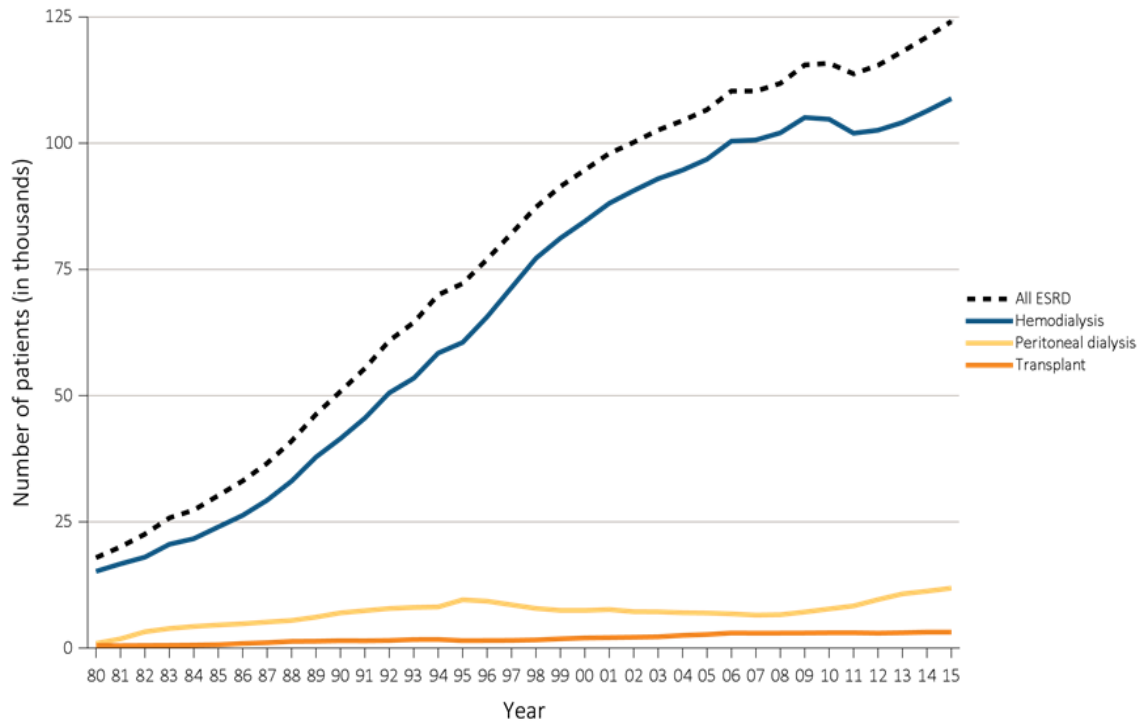
2016: 703,243 ESRD patients at USA

Treatment modality:

Hemodialysis	443,043 (63%)
Transplant	203,940 (29%)
Peritoneal dialysis	49,227 (7%)



vol 2 Figure 1.2 Trends in the annual number of ESRD incident cases, by modality, in the U.S. population, 1980-2015



Data Source: Reference Table D1. Abbreviation: ESRD, end-stage renal disease.

**How
Patients
Start?**



Cost comparison of Peritoneal Dialysis versus Hemodialysis for end-stage renal disease

Prior analyses of Medicare enrollees have consistently reported lower healthcare costs among patients who initiated dialysis with PD rather than HD

Berger et al analyzed retrospectively cost for first 12 mo of initiation of RRT 463pts

HD cost-\$173,507 (\$43,510 higher)

PD cost-\$129,997

HD was associated with more than a 2-fold increased risk of hospitalization relative to PD (hazard ratio, 2.17; 95% CI, 1.34-3.51; $P < .01$)

Medicare expenditures were reported to be \$11,446 lower for PD patients than for HD patients (\$56,807 vs \$68,253, $P < .001$) after 1 st year.



Berger A¹, Edelsberg J, Inglese GW, Bhattacharyya SK, Oster

G. Am J Manag Care. 2009 Aug;15(8):509-18.

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Is survival the same for different forms of RRT?

vol 2 Table 5.3 Adjusted survival by treatment modality and incident cohort year (year of ESRD onset)

	3 months (%)	12 months (%)	24 months (%)	36 months (%)	60 months (%)	=5 years
Hemodialysis						
2002	91.2	75.0	61.4	51.0	36.0	
2004	91.1	75.2	62.3	52.1	37.5	
2006	91.3	75.9	63.5	53.7	39.1	
2008	91.6	76.9	64.9	55.2	40.6	
2010	91.8	77.8	66.2	56.8	41.8	
Peritoneal dialysis						
2002	95.8	82.8	68.2	56.9	41.5	
2004	96.2	85.0	71.9	60.8	45.7	
2006	97.0	86.7	74.0	62.7	47.5	
2008	97.5	88.6	76.5	66.4	50.4	
2010	97.4	89.3	77.8	67.6	51.7	
Deceased-donor transplant						
2002	95.0	89.8	84.3	79.3	68.5	
2004	96.2	90.5	85.4	79.7	69.7	
2006	96.0	91.4	86.9	82.7	72.6	
2008	96.8	92.7	88.5	84.4	74.4	
2010	97.2	93.1	89.3	85.4	75.6	
Living-donor transplant						
2002	97.5	94	89.8	85.9	77.4	
2004	98.3	95.3	92.1	88.6	81.4	
2006	98.7	96.3	93.7	90.8	83.6	
2008	98.6	96.8	94.4	91.4	85.7	
2010	99.2	97.5	95.8	93.0	87.6	

Data Source: Reference Tables I.1_adj-I.36_adj. Adjusted survival probabilities, from day one, in the ESRD population. Reference population: incident ESRD patients, 2011. Adjusted for age, sex, race, Hispanic ethnicity, and primary diagnosis. Abbreviation: ESRD, end-stage renal disease.



USRDS report

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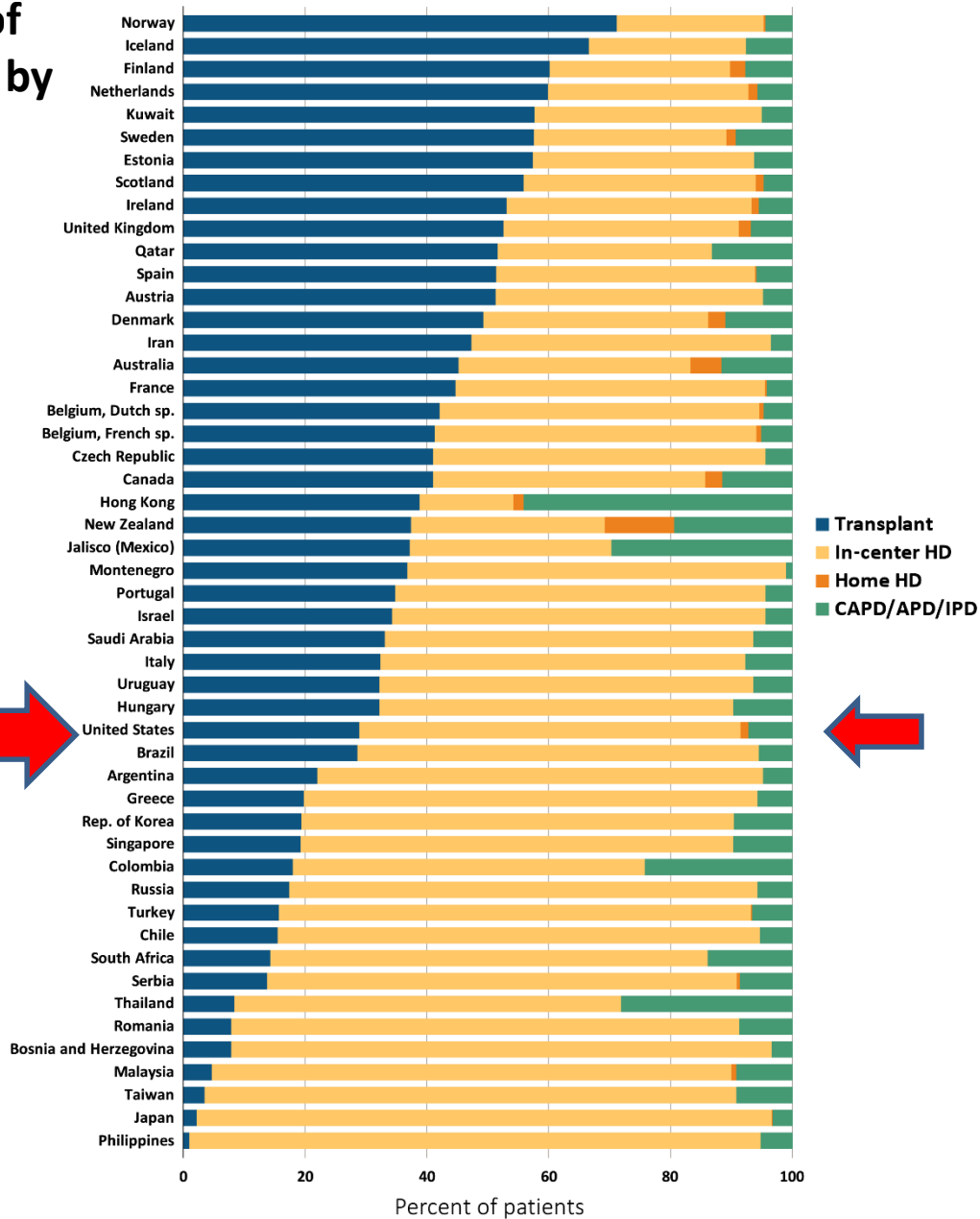
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Figure i.33 Percent distribution of type of renal replacement therapy modality used by ESRD patients, by country, 2014



Green=PD

Data Source: Special analyses, USRDS ESRD Database. Denominator is calculated as the sum of patients receiving HD, PD, Home HD, or treated with a functioning transplant; does not include patients with other/unknown modality. Data for Spain include 18 of 19 regions. Data for France include 22 regions. Data for Italy include 6 regions. Data for Canada excludes Quebec. Abbreviations: CAPD, continuous ambulatory peritoneal dialysis; APD, automated peritoneal dialysis; IPD, intermittent peritoneal dialysis; ESRD, end-stage renal disease; HD, hemodialysis; PD, peritoneal dialysis; sp., speaking. This graphic is adapted from Figure 13.12.



Lets talk more about Peritoneal Dialysis



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What are the absolute **contraindications** to PD?

1. Patient is blind and has no partner to perform PD
2. Patient is homeless
3. House/ apartment is very small/no storage space
4. Multiple abdominal surgeries in the past

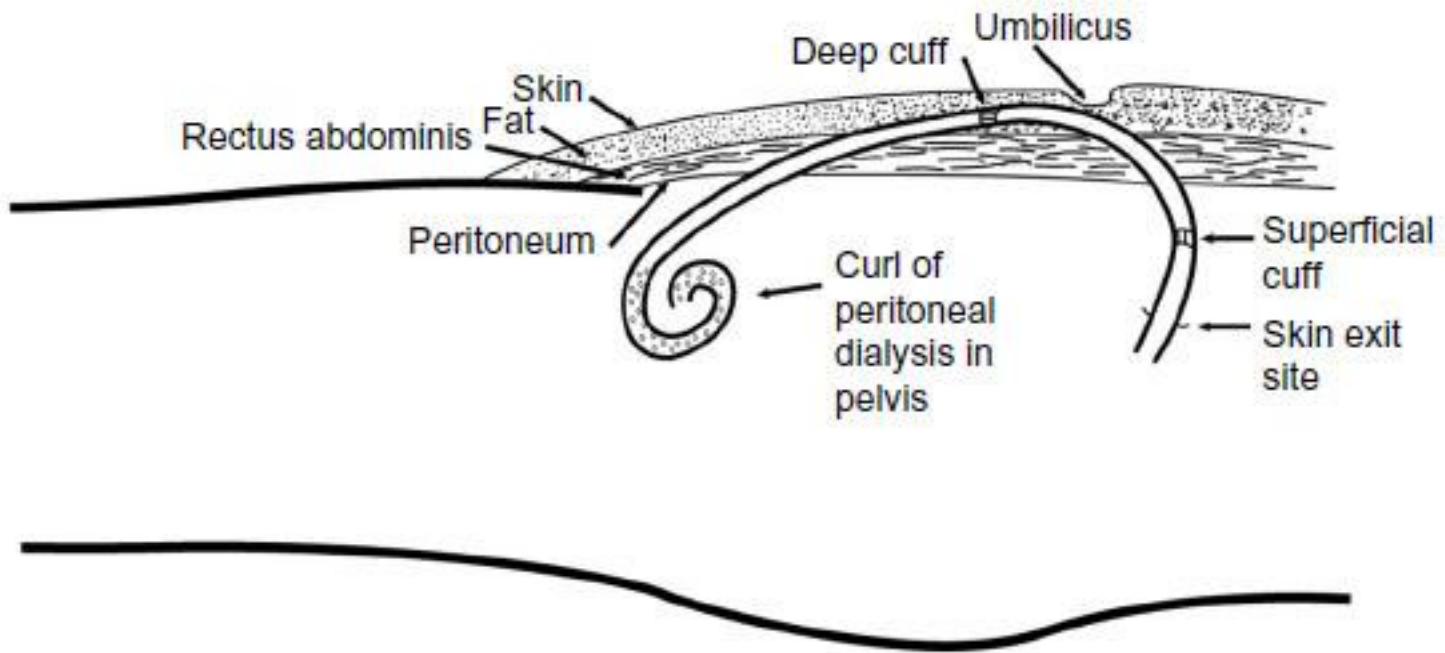


Keys to Success of Peritoneal Dialysis

- Qualifying Patient
- Outpatient PD program with Medical Director
- Team of providers: Nephrologist, PD nurse, Dietitian, Social Worker, Surgeon
- Patient and Family education
- Hospital and Extended care facility interaction
- Assessment of quality goals, monthly Quality Assessment and Performance Improvement Meetings

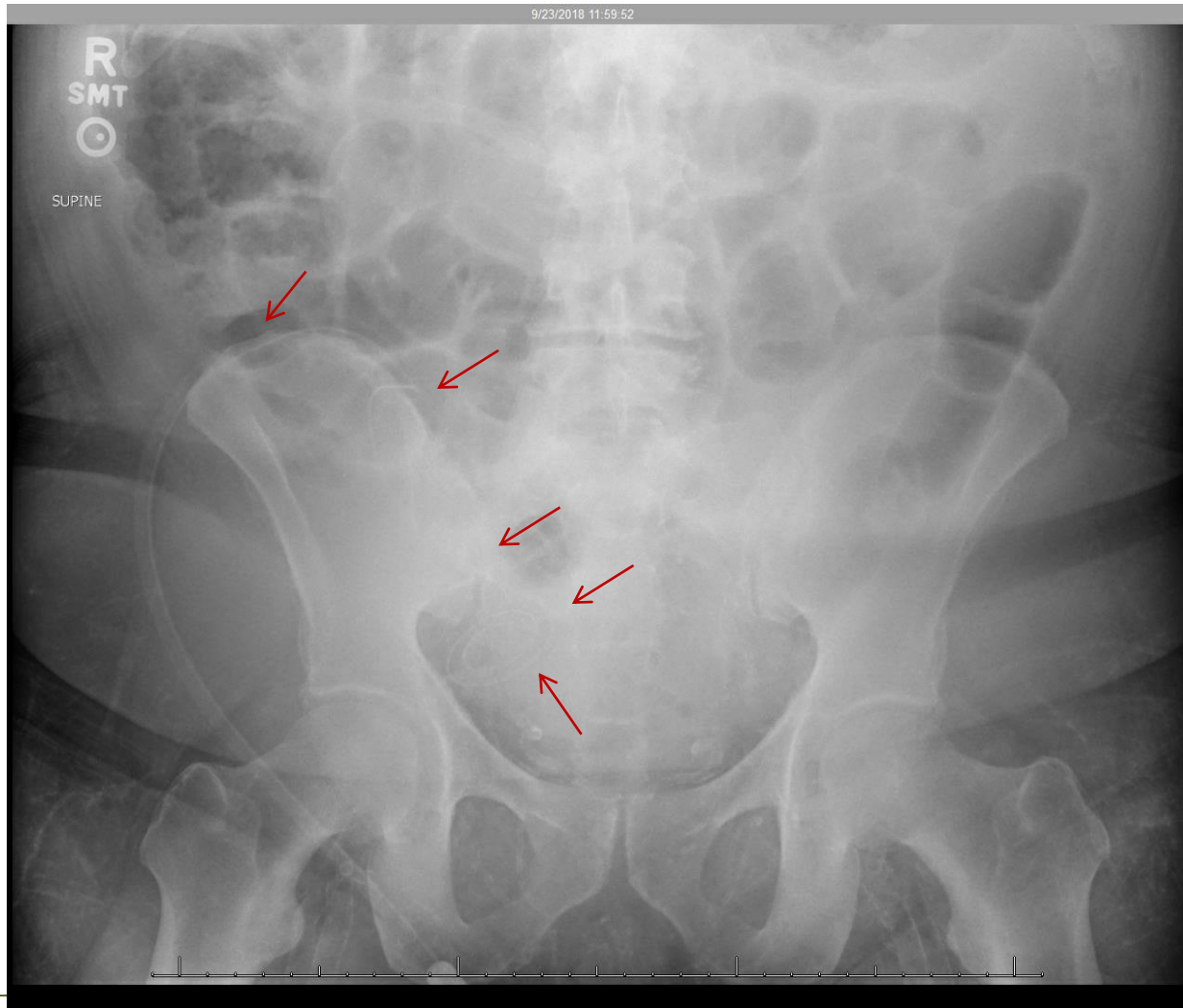


HOW DOES PD CATH WORKING?



Why Do We Need KUB?

-To evaluate the position of the catheter



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Basic Principles. How Does Peritoneal Dialysis Work?

Peritoneum serves as a membrane permeable to fluids and solutes

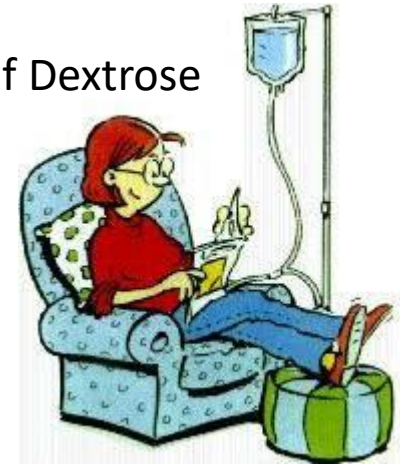
Dialysate (fluid for dialysis) get infused into the peritoneal cavity through the catheter

Fluid dwells in the cavity for few hours on average

Solute get shifted by concentration gradient (BUN and K diffuse to dialysate)

Excess interstitial volume get pulled by high osmotic gradient of Dextrose
(patient drains more fluid than was put in)

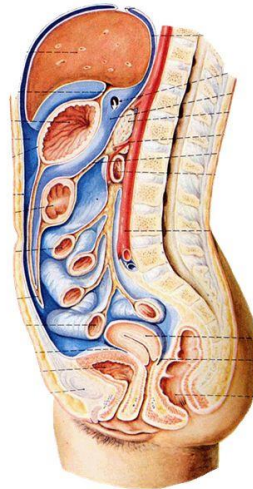
Diffusion and convection



Basic Principles. How Does Peritoneal Dialysis Work?

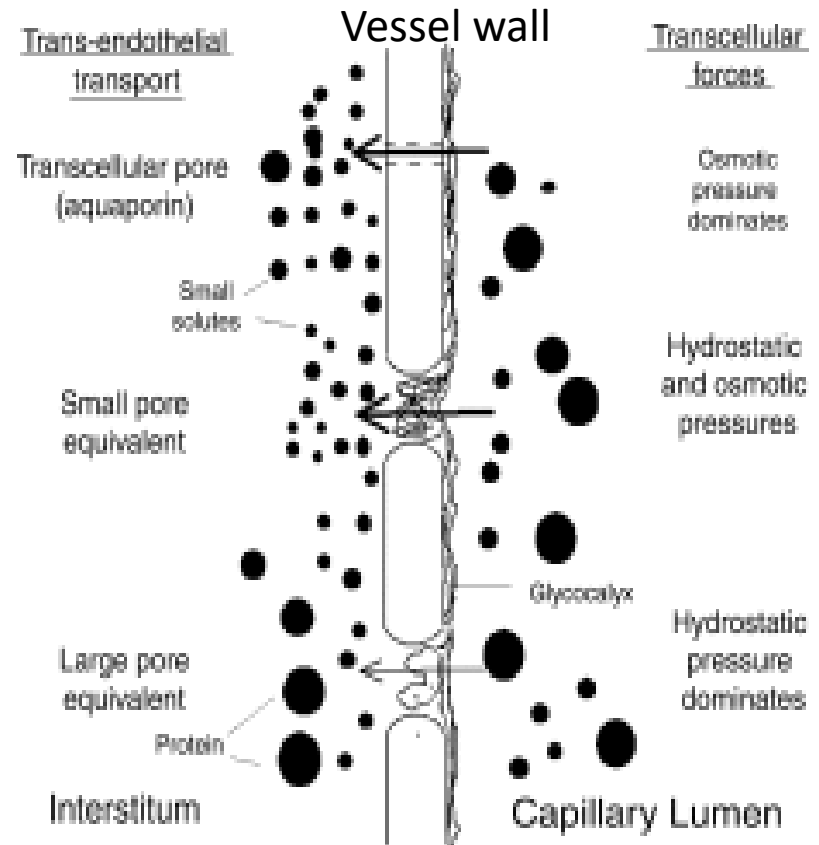
General features

- The peritoneum is a thin serous membrane that line the walls of the abdominal and pelvic cavities and cover the organs within these cavities
- **Parietal peritoneum** - lines the walls of the abdominal and pelvic cavities
- **Visceral peritoneum** - covers the organs



Size 1.5-5m², approximates BSA
Semi-permiable, bi-directional
Highly vascular

3 pore model of PD



History of Peritoneal Dialysis (1 of 2)

In the late 1940s, Fine and colleagues reported successful peritoneal irrigation in a patient with severe anuria, who survived after 4 days of continuous peritoneal lavage.



This was indeed a landmark in the history of treatment of uremia using the peritoneal cavity.

In the late 1960s, intermittent peritoneal dialysis (PD; provided once or twice a week in hospital) was practiced worldwide, but mainly in three centers: Seattle, Montpelier France and in Toronto.

In all these centers PD was provided mainly to patients who could not be dialyzed with hemodialysis (HD). Patients would come to the hospital one or two days a week and start on PD with a new stylet catheter inserted into their abdomen each time.

As soon as a patient on chronic HD would die, one of those patients, who had survived the longest on PD, would be rewarded by being moved to HD.



Dimitrios G. Oreopoulos, MD, PhD; Elias Thodis, MD The History of Peritoneal Dialysis: Early Years at Toronto Western Hospital. Dialysis & Transplantation August 2010

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History of Peritoneal Dialysis (2 of 2)

1962 Tenckhoff designed indwelling silicone rubber catheter with 2 Dacron cuffs.
That made PD long-term therapy.

1978 – University of Toronto replaced glass fluid containers to plastic bags

1979 Baxter to manufacture solution, tubing, antiseptic solutions

1979 –Y system developed in Italy (decreased rate of peritonitis)

1981 –Cycler manufactured (continued automated therapy)

1984 – International Society of PD established

1990 s- better polymer technology in PD cath

1992 – extended PD catheters introduced

1993 -Advanced glycosylation end products recognized

2002 – Extraneal solution (starch based) FDA approved

2008 - Phisoneal solution (starch based) approved, not in USA

2010 – Nutrineal solution (amino acids) approved in Europe,2012 USA



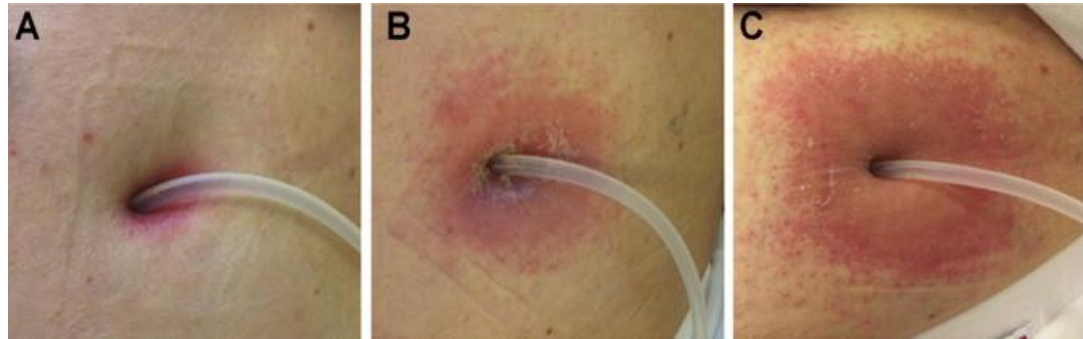
Dialysate Solutions Used for Peritoneal Dialysis in USA

Solution	Dianeal 1.5%	Dianeal 2.5%	Dianeal 4.25%	Icodextrin 7.5 g/dl	Nutrineal (aminoacids)
Sodium	132	132	132	132	132
Chloride	96-102	96-102	96-102	96	
Calcium	3.5, 2.5	3.5, 2.5	3.5, 2.5	3.5	2.5
Magnesium	0.1-1.5	0.1-1.5	0.1-1.5	0.5	0.5
L-Lactate	35,40	35,40	35,40	40	40
Osm	346-485	346-485	346-485	282-286	346
pH	5.2	5.2	5.2	5.2	6.5

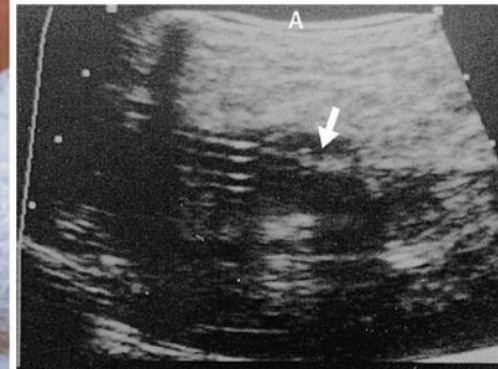


Infectious Complications of Peritoneal Dialysis

1. Exit site infection



2. Tunnel infection



3. Peritonitis



Causes of Peritonitis

1. Touch Contamination/breaking the aseptic technique
2. Catheter related infection (defect, pets bite, contaminated water..)
2. Trans visceral migration due to intra-abdominal pathology
3. Hematogenous
4. Procedure related: GI, GU, dental



Patient Education for Prevention of Infection

While taking care of the PD catheter

- Use mask for all people in the room
- Gloves or clean dry hands
- Doors and window are closed
- Avoid catheter directed air conditioner flow
- No pets in the room while connection is ongoing
- Antibiotic cream around exit cite daily
- Dressing change daily
- Bags, tubing inspection for defects
- Antibiotics prophylaxis before colonoscopy/GU and dental procedures



KEEP IT CLEAN=SAVE PATIENT'S LIFE

Peritonitis is a fear of every patient and team caring for him/her

Peritonitis can cause death or inability to continue PD

Health care providers in the hospital/office:

- PD catheter care provided ONLY by patient or PD nurse

ALL OTHERS

- Do not remove dressing
- Do not attempt to drain
- Do not access catheter with a syringe or remove covering cap
- Do not collect fluid for culture
- Call PD nurse



Diagnosing Peritonitis in patient on PD

- Abdominal pain
- Weakness, nausea, loss of appetite
- Change in bowel : new diarrhea or constipation
- Cloudy fluid
- Different than non-PD peritonitis
- Fever, rigors, blood WBC and chills are quite uncommon

PD fluid cell count: WBC>100 with >50% PMN (granulocytes) cells

Results Review Last Refresh: 9/23/2018 11:53 Time Mark Back Forward View Hide Tree Ref Range Load All Flowsh

Search: [] Hide data prior to: 1/23/2011 Use Date Range Wizard

ALL TOPICS

- Results
 - LABORATORY RESULTS
 - CHEMISTRY
 - HEMATOLOGY
 - BLOOD BANK
 - IMMUNOCHEMISTRY
 - MICROBIOLOGY
 - MOLECULAR
 - URINE
 - PULMONARY DIAG
 - BODY FLUIDS**
 - OTHER TESTS
 - PATHOLOGY/CYTOLOGY
 - STOOL TESTS
 - ONCOLOGY
 - TUMOR/MALIGNANCY MARKERS
 - RADIOLOGY/IMAGING
 - CT SCAN

HEMATOLOGY/CELLS, FLUID					
Cells Counted		100			100 *
Fluid WBC		4,278 !			915 *
Fluid RBC		22			6 *
RBC	2.98 !		3.38 !	3.56 !	
Fluid Granulocytes		74 !			97 *
Fluid Lymphocytes		10			3 *
Fluid Eosinophils		6 !			
Fluid Macrophage		10 !			
Color		Pale Yellow			Yellow *
Fluid Appearance		Cloudy			Cloudy *
Fluid Type		Peritoneal			Peritoneal *
OTHER FLUID TESTS					
Body Fluid Culture					No Growth at 48...



How do we treat Peritonitis Related to PD?

ISPD (international society of PD) guidelines

Intra-abdominal antibiotics

Empiric coverage to start GP+GN

Intraperitoneal dosing for 2-3 weeks

Removal of PD cath only with Fungal infection
or resistant to targeted Abx therapy for >5 days



Audience Participation Quiz



What can be the reason for hemoperitoneum in PD patient?

- 1.
- 2.
- 3.



Diet for Patient on Peritoneal Dialysis

Diet for the patient on PD is much more liberal than on hemodialysis.

While phosphorus restrictions still implies, potassium restriction most of the time is not necessary.

PD patients are frequently hypokalemic and required potassium supplements.

It is common knowledge that potassium rich food frequently comes from healthy choices like fruits and vegetables, which most of the people enjoy to consume.

Less restrictive diet contributes to the better lifestyle on peritoneal dialysis.

Use of specifically designed renal vitamins supplements they need in nutrition.



Blood Pressure and PD

- Patients do not have drastic changes of BP
- Hypotensive episodes on PD almost unheard of
- Good for patients with autonomic dysfunction
- Easy for preload - dependent patients with valvular disease
- Better opportunity to use ACE-I/ARB/MRB as potassium is low
- Overall much easier on hemodynamics than HD



Travel with Peritoneal Dialysis



Easiness of travel is one of the big advantages

Cycler is portable

Peritoneal dialysis fluid can be delivered to hotel/cruise ship by Baxter

International travel possible (by law no fee for travel with medical equipment)

Preserved flexibility of travel plans

Keep the job which requires travel



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Peritoneal Dialysis in Selected Populations



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PD for Big Girls and Boys

adequate dialysis has been achieved in clinical studies in patients with BMI up to 46 kg/m².

Pre-Sternal bathtub catheter

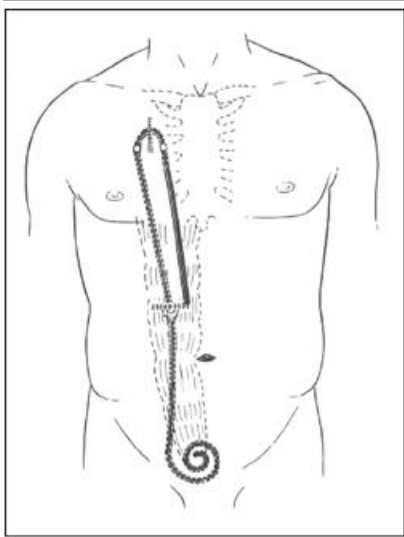


Figure 1: Drawing of presternal catheter



Figure 2: Photo of presternal catheter



Upper Abdomen



Upper Chest



<https://www.homedialysis.org/life-at-home/articles/the-bathtub-presternal-pd-catheter>

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Novel Indications for Peritoneal Dialysis

Peritoneal Dialysis for Heart Failure Patients with CKD

Table 2

Selected studies on the role of peritoneal dialysis in heart failure

Ref.	Study design	No. of patients	Mean age (yr)	Male gender	NYHA class	EF	Renal function	Main findings	Comment
Koch et al[11]	Prospective	118	73.2	60.2%	III (49.2%) IV (50.8%)	43.5%	Creatinine clearance 19.2 mL/min	Significant improvement in body Weight and NYHA class	Negligible incidence of peritonitis and catheter dysfunction
Núñez et al[8]	Prospective	25	75.1	72%	III or IV (100%)	40%	eGFR 33 mL/min per 1.73 m ²	Significant improvement in patients' clinical status and NYHA class	Marked reduction in the number of days hospitalized for acute heart failure
Bertoli et al[12]	Multicenter retrospective	48	74	81%	II (6%) III (48%) IV (46%)	30%	eGFR 21 mL/min per 1.73 m ²	Significant improvement in NYHA class and reduction in the number of days hospitalized	Significant reduction in pulmonary artery pressure and improvement in EF
Courivaud et al[10]	Retrospective	126	72	69%	N/A	38%	eGFR 33.5 mL/min per 1.73 m ²	Significant reduction in the number of days hospitalized for acute heart failure	Improvement in cardiac function in patients with an EF of 30% or less

NYHA: New York Heart Association.



Kazory A. Peritoneal dialysis for chronic
cardiorenal syndrome: Lessons learned from ultrafiltration trials
World J Cardiol. 2015 Jul 26; 7(7): 392–396.

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Peritoneal Dialysis in Patients with decompensated cirrhosis

Peritoneal dialysis PD-ideal treatment in cirrhotic patients with ascites

Two datasets including a cohort study of China Medical University Hospital (CMUH) from 2004 to 2013 and the Longitudinal National Health Insurance Database for Catastrophic Illness Patients (LHID-CIP) of Taiwan from 1996 to 2011 were analyzed.

The survival of cirrhotic patients on PD and the propensity score matched cirrhotic patients on HD were analyzed using Cox proportional hazards regression.

PD in cirrhotic patients who need dialysis is associated with lower all-cause mortality than HD is.

This association is independent of patients' comorbidity, severity of liver cirrhosis, and serum albumin levels.



Che-Yi Chou et al. Peritoneal Dialysis is Associated
With A Better Survival in Cirrhotic Patients
With Chronic Kidney Disease. *Medicine* (Baltimore). 2016 Jan; 95(4): e2465.

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PD for patients with Mental Disabilities

Patients who pull, pick, move, jump – extremely difficult for hemodialysis

PD with a catheter with back exit site is an option



Penner T. Peritoneal Dialysis Catheters with Back Exit Sites.
Perit Dial Int. 2013 Jan-Feb; 33(1): 93-96.

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Choosing PD in Natural Disasters

Hurricanes, earthquakes, nuclear accidents studies showed how vulnerable hemodialysis patients are. They are highly dependable on medical equipment, purified water, trained staff.

PD patients trained to do manual exchanges only need bags of PD solutions

“ Our experience shows the reliability of PD in emergency situations and should further encourage using PD as the initial modality of renal replacement therapy.”

Literature on use of urgent PD in combat related kidney failure



Kemura K. et al. A Reason for Choosing Peritoneal Dialysis: Lessons After the Japan Earthquake and the Fukushima Nuclear Accident. AJKD 2012

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What is New for PD in 21 st Century?

Remote patient management

Cloud-based platform allowing two-way life time communication

Fast response to alarms on therapy and troubleshooting

Remote monitoring of labs collected locally

Access to daily weight, BP, HR data

Monitoring of compliance

Overcoming geographic and socioeconomic barriers



Advantages of Peritoneal Dialysis

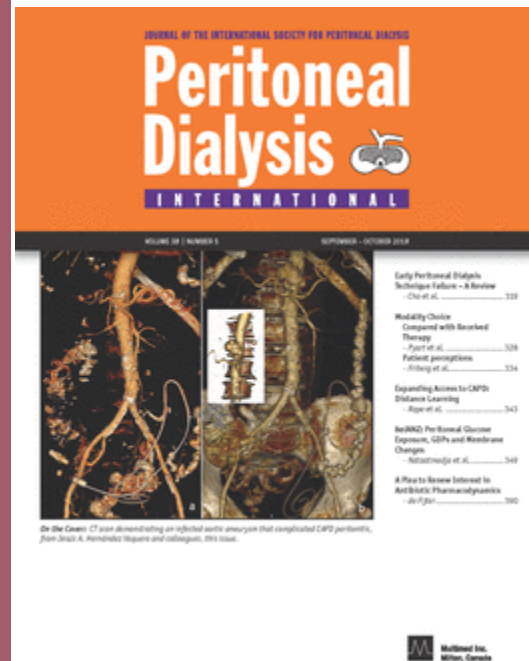
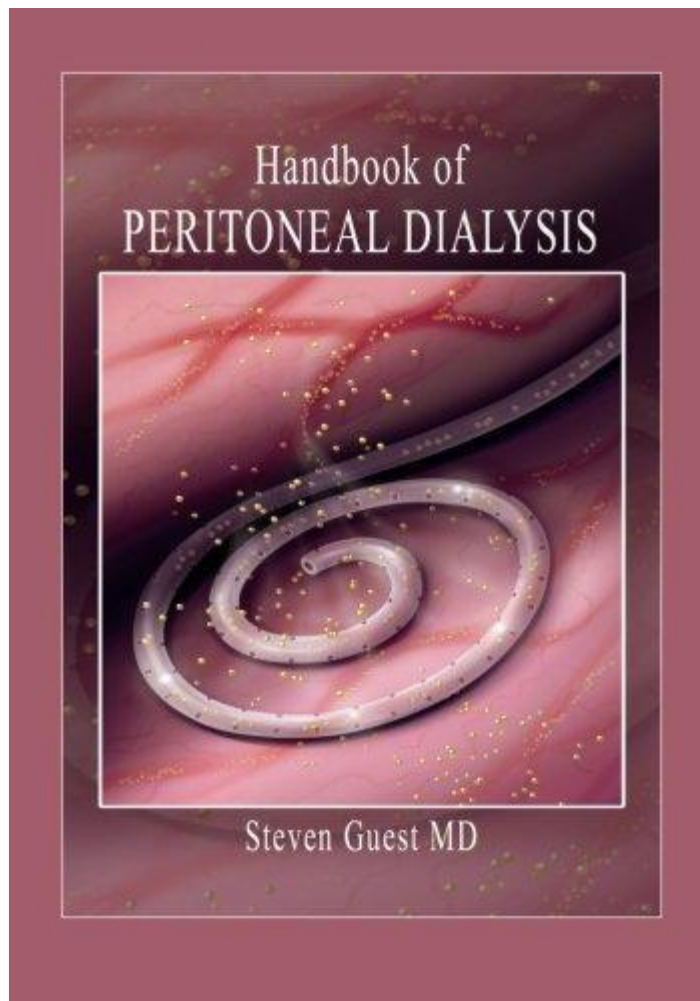
Peritoneal dialysis offers a variety of benefits over in-center hemodialysis.

Studies show evidence of benefits for PD related to survival, quality of life, transportation costs, increased patient autonomy, and clinical benefits including enhanced blood pressure and phosphorus control.

Furthermore, the cost of delivery of care of home modalities in most countries is less than that of in-center hemodialysis



Resources for PD education for Clinicians



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**17th Congress of the
International Society for Peritoneal Dialysis**
VANCOUVER, CANADA | MAY 5-8, 2018



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THANK YOU
For CHOOSING PD



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