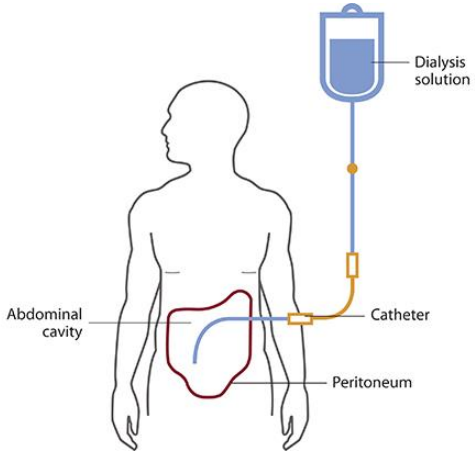

Underutilized and Underappreciated- A Guide to Peritoneal Dialysis

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Boca Raton Regional Hospital Grand Rounds
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Disclosures

- Nothing to disclose

Objectives

- understand the mechanism of peritoneal dialysis
- learn the barriers preventing patients from starting peritoneal dialysis
- appreciate the infectious and non infectious causes of PD

Chronic Kidney Disease

Table 1. Stages of CKD[a]		
Stage	**Description**	**GFR (mL/min/1.73 m²)**
1	Kidney damage with normal or GFR	≥ 90
2	Kidney damage with mild GFR	89-60
3A	Mild to moderate GFR	59-45
3B	Moderate GFR	45-30
4	Severe GFR	30-15
5	Kidney failure	< 15 or dialysis

CKD, chronic kidney disease; GFR, glomerular filtration rate.

[a]Adapted from the Renal Association. http://www.renal.org/whatwedo/InformationResources/CKDeGUIDE/CKDstages.aspx. Accessed November 16, 2013.

CKD 3-5: 28,000,000 (USRDS 2011)

Most common causes:

- HTN (1 in 5)
- DM (1 in 3)
- Vascular disease

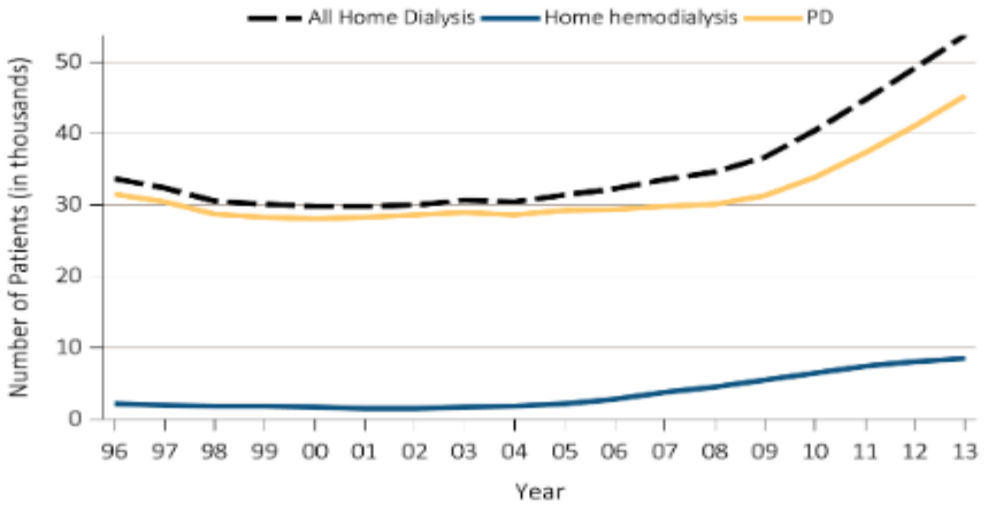
ESRD Statistics in the USA

- ESRD 660,000
  - Dialysis 475,000
  - Transplant 185,000
- In 2014, 121,000 people became ESRD
- >100,000 patients on transplant waiting list
  - 19,000 transplants in 2015 (majority from deceased donors)

Modality Distribution

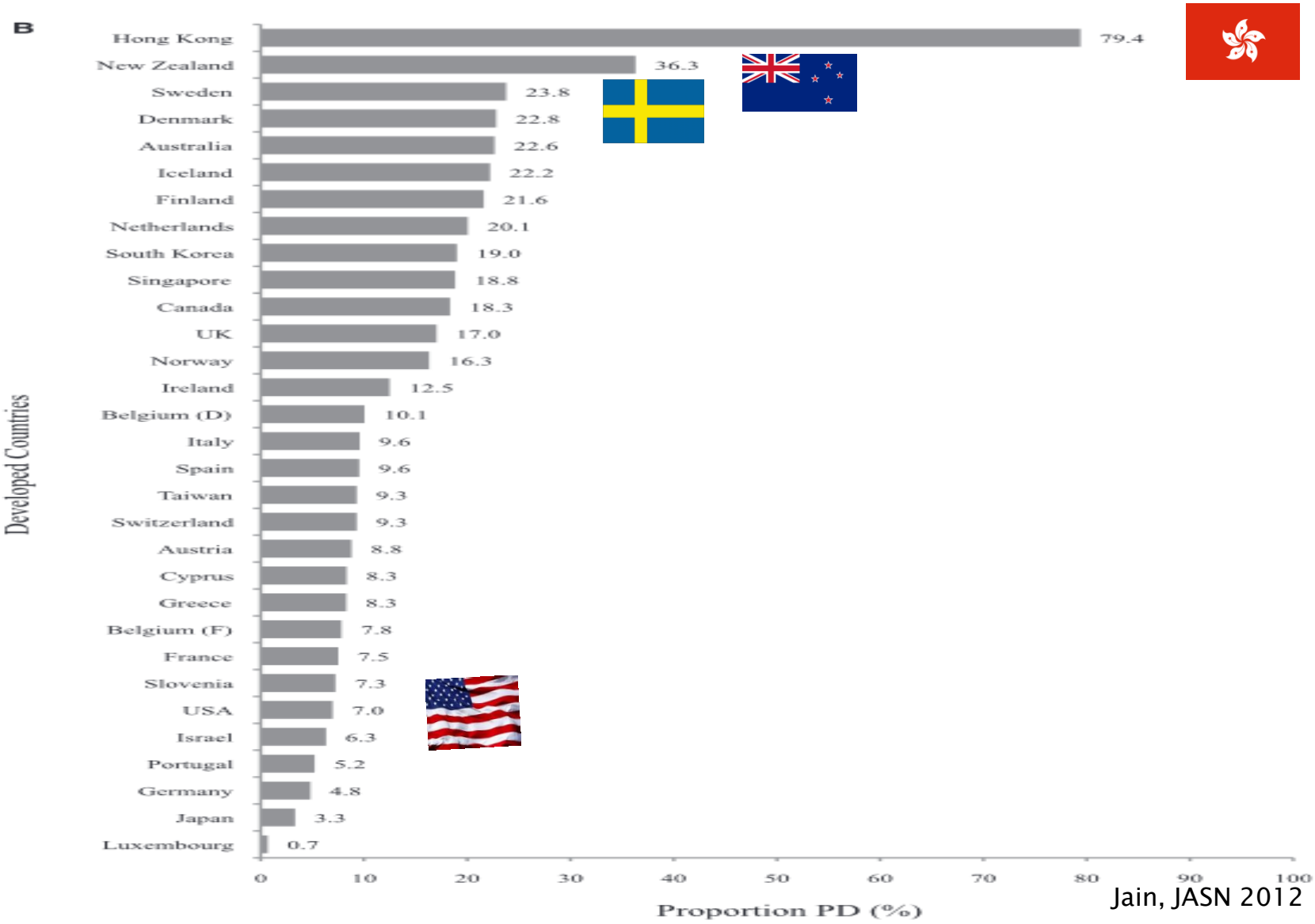
- 2015:
- In-center HD 89%
- Home Dialysis 11%
  - Peritoneal Dialysis
  - Home Hemo

vol 2 Figure i.3 Trends in number of prevalent ESRD cases (in thousands) using home dialysis, by type of therapy, in the U.S. population, 1996-2013



USRDS 2015

PD percentage per Country

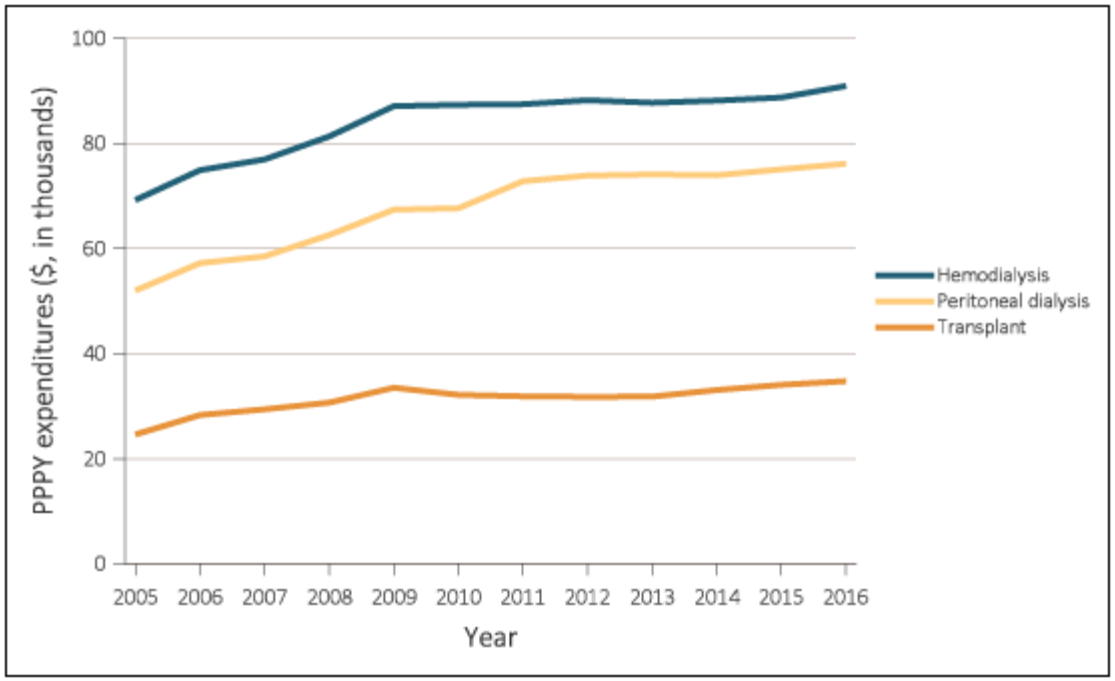


Jain, JASN 2012

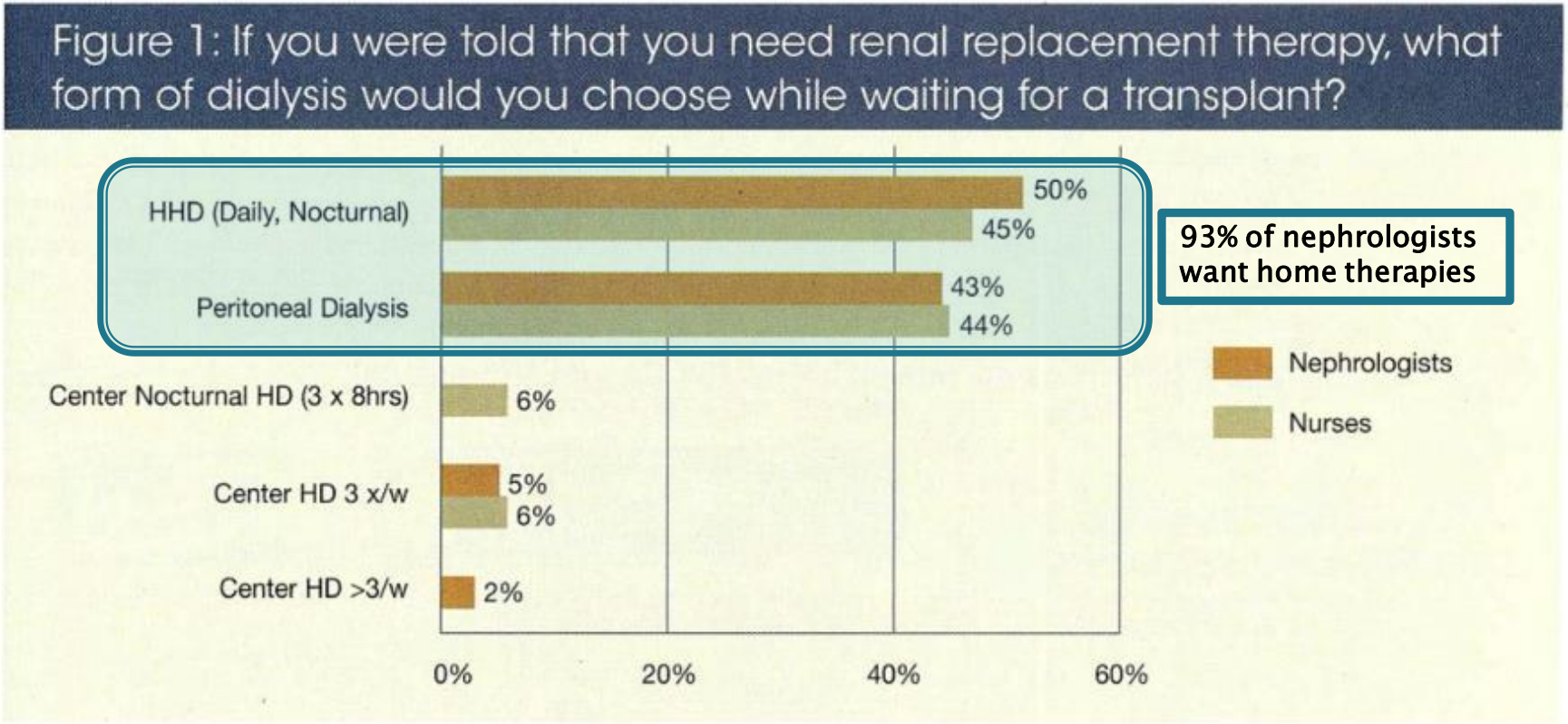
ESRD Costs in the US (USRDS 2016)

- $35.4 billion
  - 7.2% of Medicare paid claims
- HD: $90,971/pt; PD: $76,177/pt
- Txplt: $36,170/pt

Total Medicare ESRD expenditures per person per year, by modality, 2004-2016



What would we want for ourselves?



Schiller, NNI, 2010

HD vs PD

- HD Advantages
  - In-center = help
  - Only 3 days a week
  - AVF (no synthetic material)
- HD Disadvantages
  - Less physiologic
  - Fluid/Osmole shifts
  - Access issues

- PD Advantages
  - More independence
  - More physiologic
  - Better electrolyte clearance
- PD Disadvantages
  - Every day
  - Access issues
  - Hyperglycemia
  - PD membrane can fail over time

Barriers to PD

- ABSOLUTE:
  - Lack of a functioning peritoneal membrane

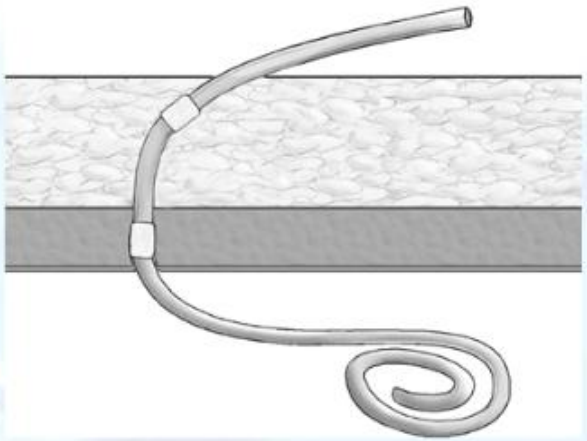
- RELATIVE:
  - Peritoneal scarring
  - Patient impairment (physical, cognitive, psych)
  - Living situation
  - Anuria
  - Large patient size
  - Abdominal inflammation, ostomies
  - Hernia

What makes a good PD candidate

- ABSOLUTE
  - Desire to perform own dialysis
- RELATIVE
  - Residual renal function (RRF)
  - Virgin abdomen
  - Vision, dexterity
  - Home environment

PD Catheter Placement

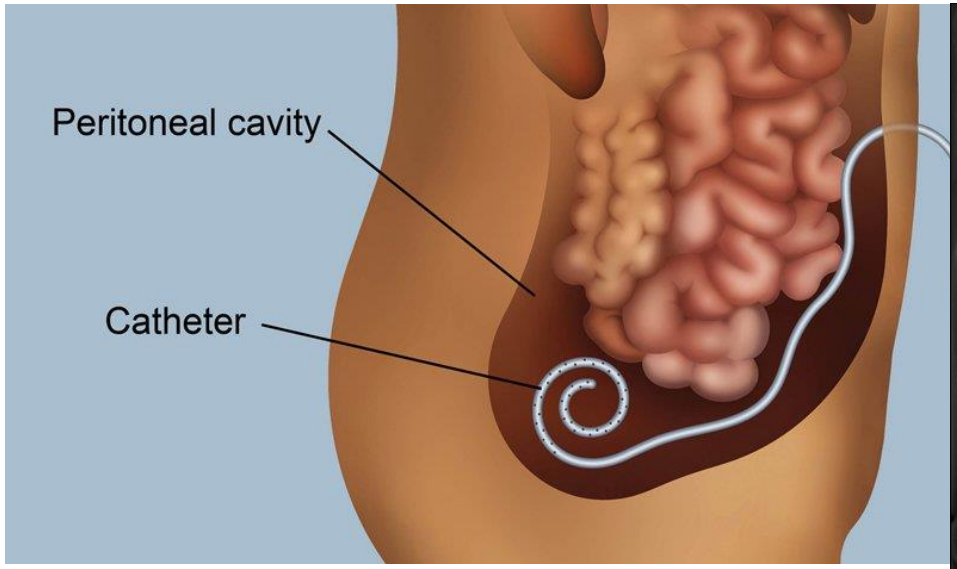
- Ideally placed about a month prior to initiating treatment
- 2 weeks to heal with weekly flushes to maintain patency
- 2 weeks of training with PD nurse

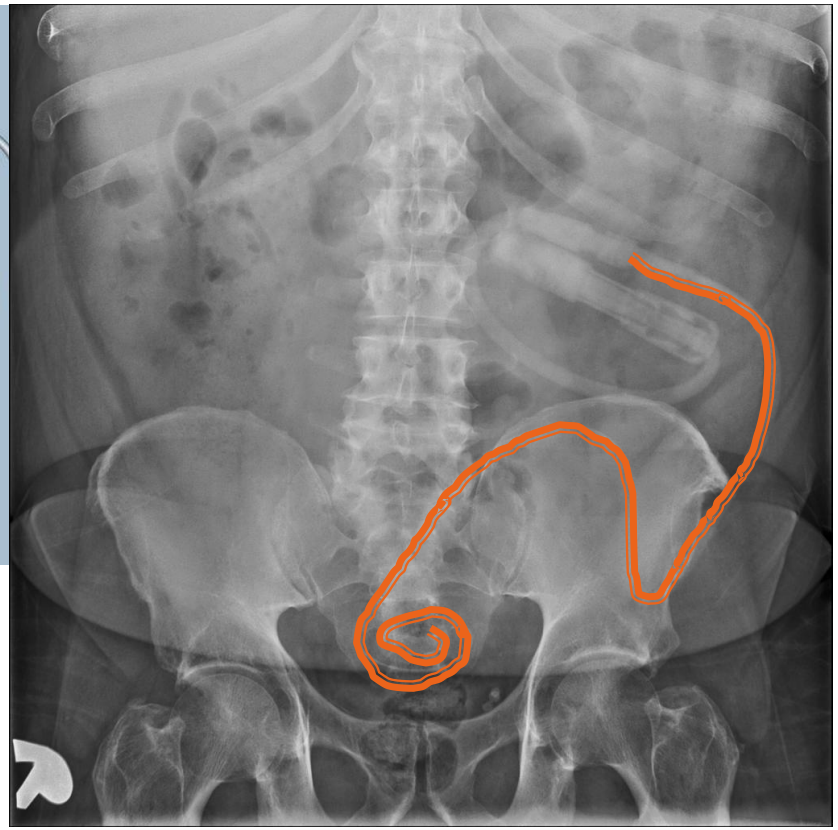


Crabtree J. Kidney Int Suppl 2006; 70: S27-37

PD Catheter Placement

- Catheter tip in deep pelvis
  - Optimal hydraulic function
  - Best way to avoid omental entrapment

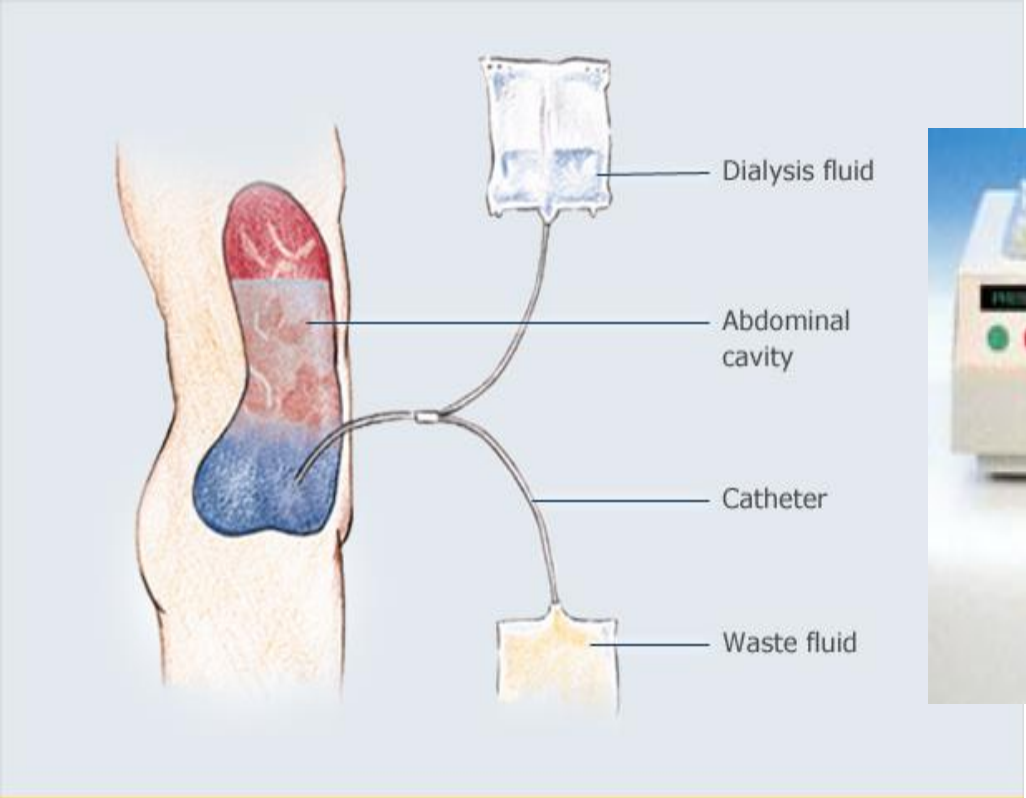


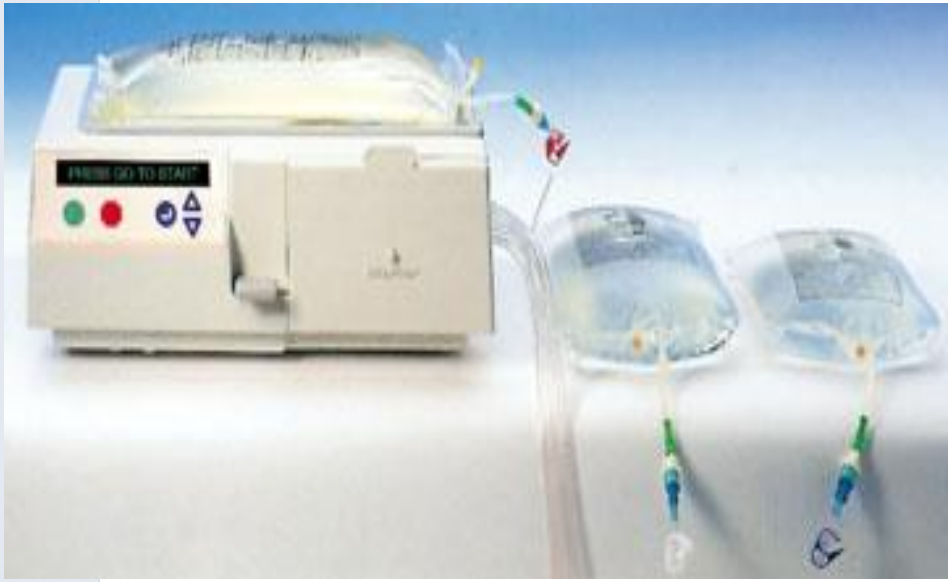


FKC, Radiopaedia

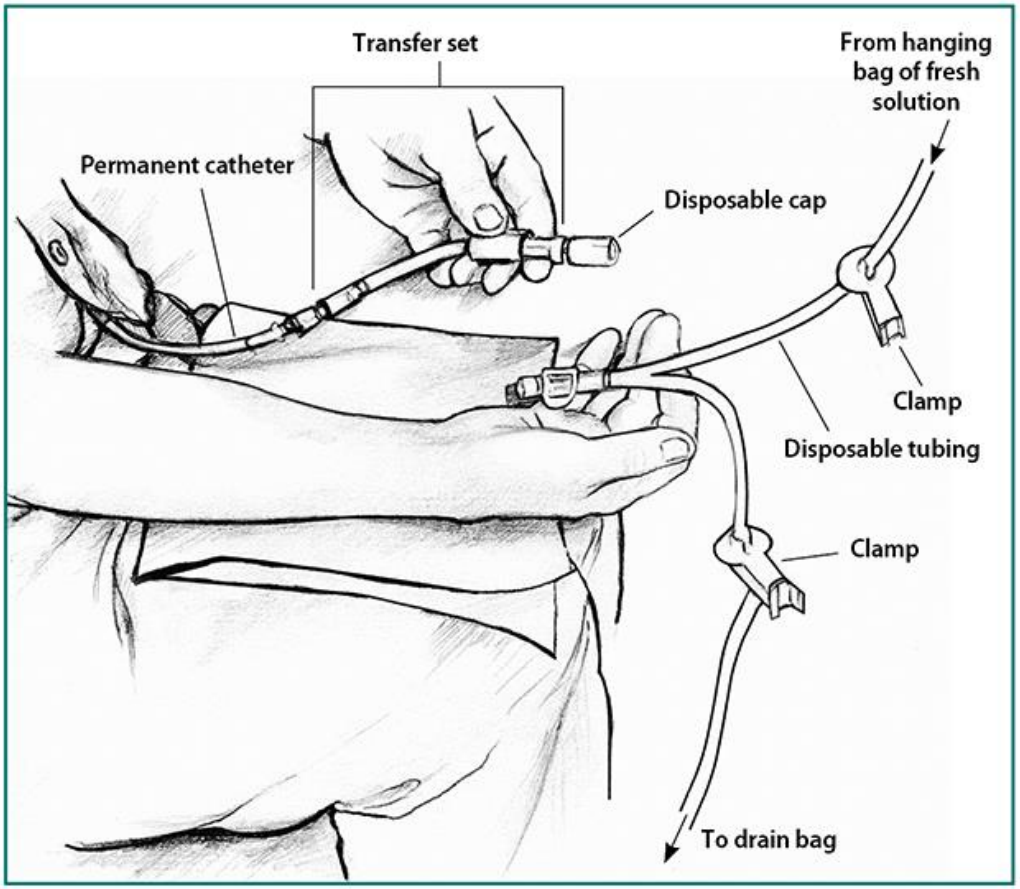
PERITONEAL DIALYSIS RX

- Continuous Ambulatory PD (CAPD)
- Automated PD (APD/CCPD)



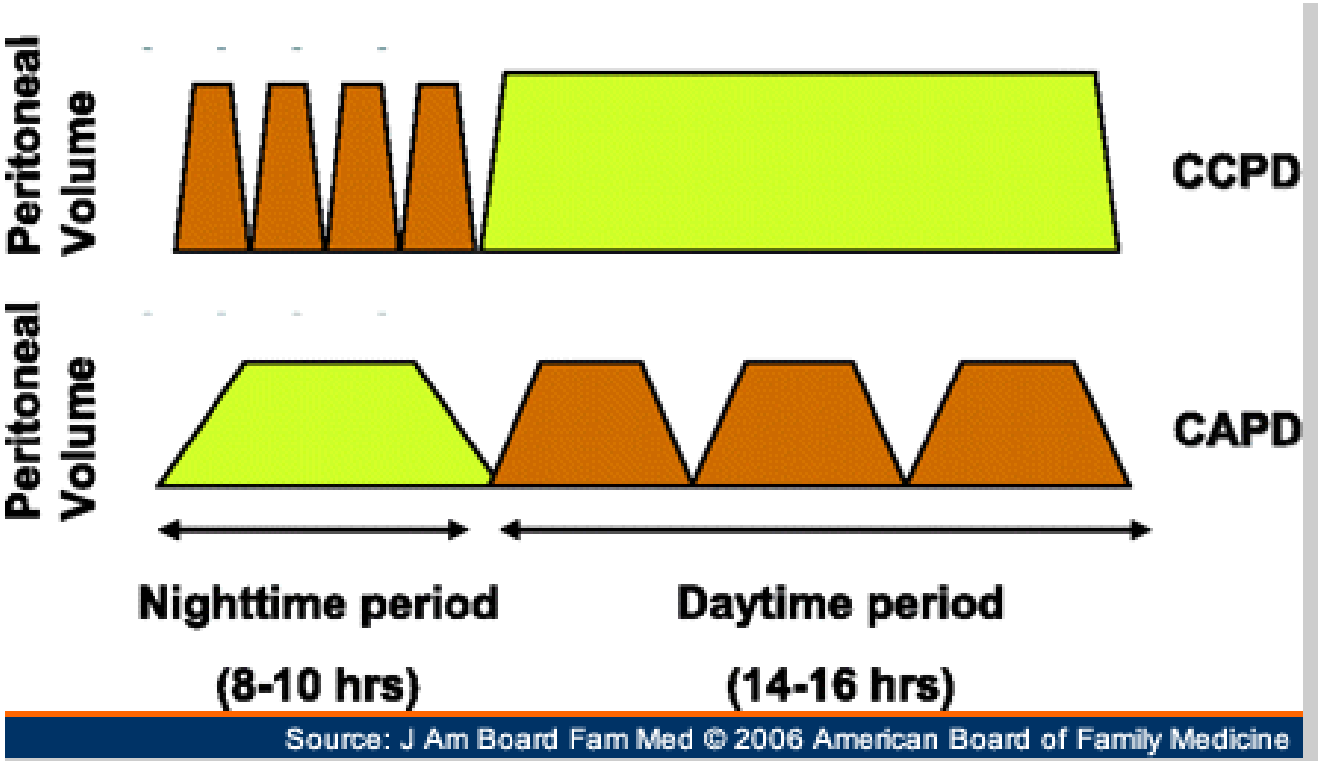


PD Apparatus



NIDDK

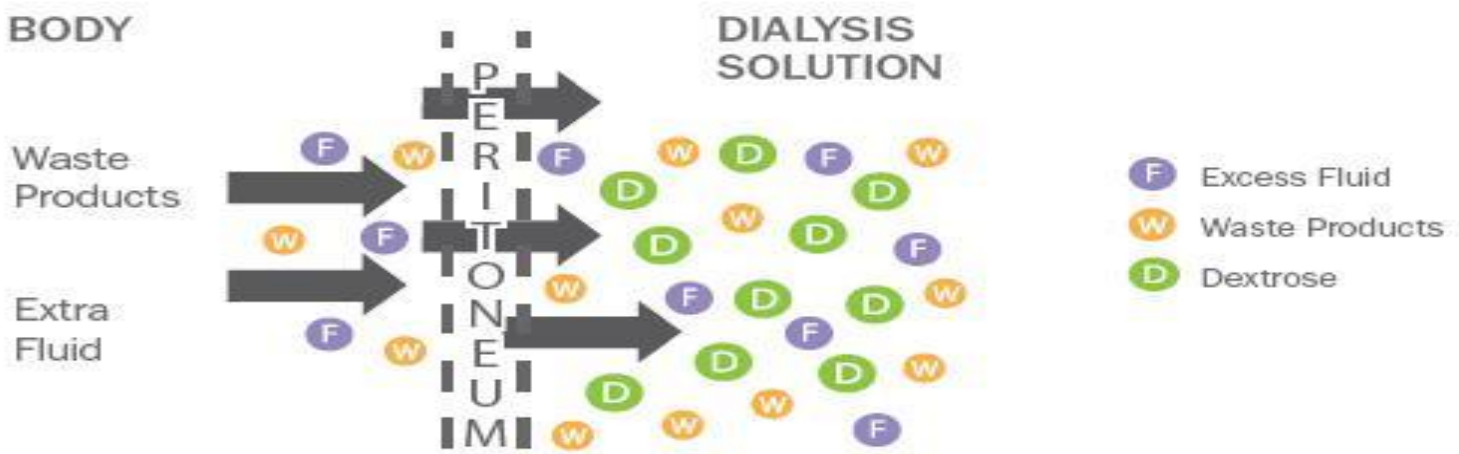
PERITONEAL DIALYSIS



CAPD vs APD

- APD more popular
  - Higher QOL (Bro, PDI, 1999)
  - Less exchanges (going to sleep, waking up)
- CAPD advantages
  - Patients who don't want to be tethered to cycler
  - Better retention of RRF?
- No difference
  - M&M
  - Infection
  - Volume mgmt

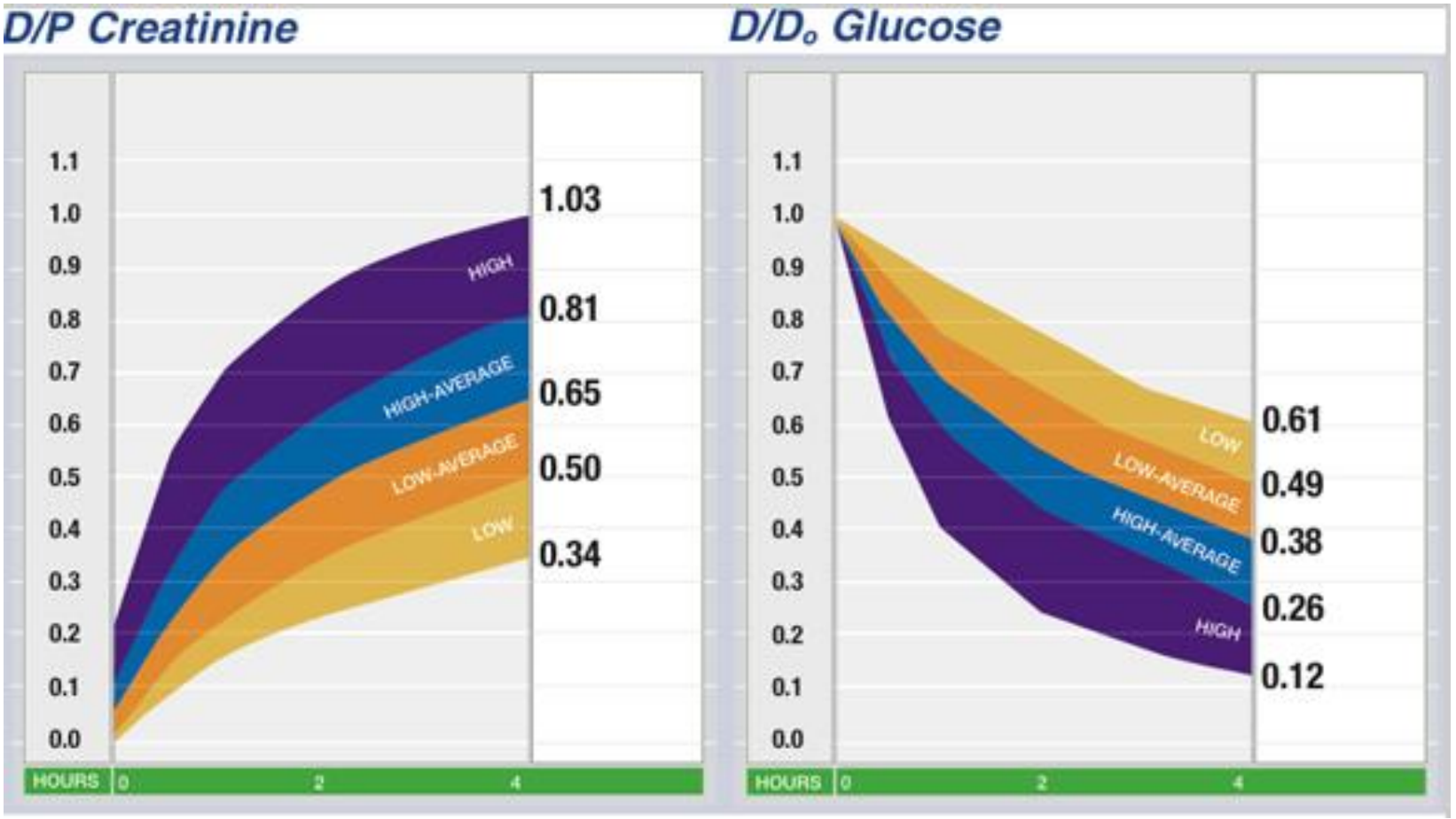
HOW PD WORKS



Peritoneal Capillary
Intracellular and Transcellular Pores

- PD fluid contains dextrose (1.5% – 4.25%) = osmotic agent to help with ultrafiltration
- Solute clearance by diffusion
- Every Peritoneal membrane is unique

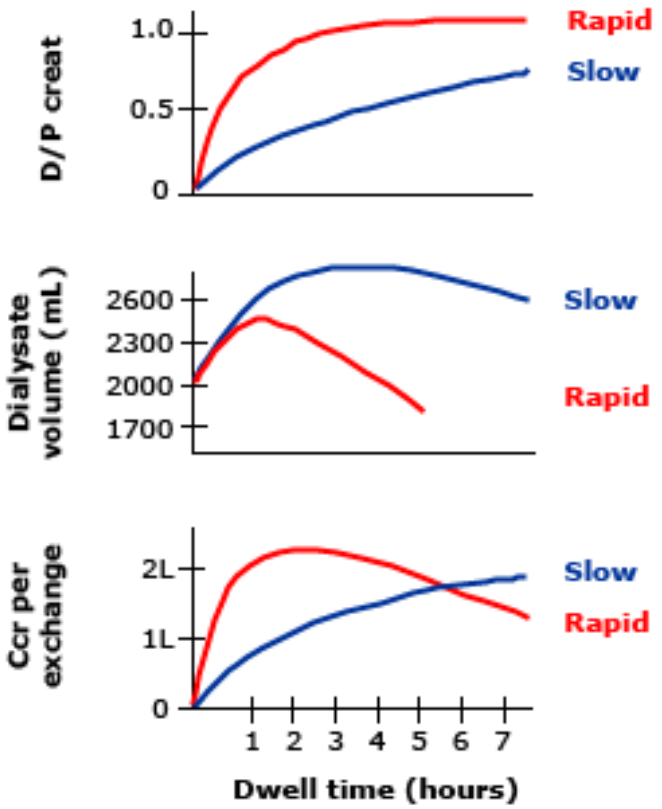
PERITONEAL EQUILIBRIUM TEST



1/6 High, 2/3 Average, 1/6 Low

Creatinine Clearance = D/P x V

Peritoneal equilibration test in rapid versus slow transporters



Creatinine removal

Ultrafiltration

Creatinine Clearance/ Exchange

UpToDate

PD Prescription

- Rapid Transporters
  - Goal: Shorter more frequent exchanges
  - Modality: APD (cycler)
- Slow Transporters
  - Goal: Longer dwells, less frequent exchanges
  - Modality: CAPD, CCPD with long day dwell
- Average Transporters
  - Either modality is appropriate

Goal of Appropriate Rx

- Successful solute clearance (Kt/V)
  - Measured quarterly
  - PD fluid + Urine (RRF)
  - Goal > 1.7
- Avoid uremic Sx
- Sufficient UF to prevent volume overload
  - Daily weight, BP, edema checks
  - Different dialysis solutions
- Maintain normal lytes and bone mineral met.
  - Monthly labs

Dialysate

- Electrolytes
  - Sodium 132 meq/L
  - Potassium 0 meq/L
  - Calcium 2.5 meq/L
  - Magnesium 0.5 meq/L
  - Chloride 95 meq/L
  - Lactate 40meq/L
- Additives
  - Heparin
  - Insulin
  - Antibiotics

- Dextrose
  - 1.5%, 15g/L
    - Osm 347
  - 2.5%, 25g/L
    - Osm 396
  - 4.25%, 42.5g/L
    - Osm 485

CAPD Rx

- Exchanges: 3-4/day
- Each exchange takes 15-30min
- Fill volume: 2-3L
- Dialysate: 1.5%, 2.5%

- UF- patient measures volume in effluent bag after each exch.

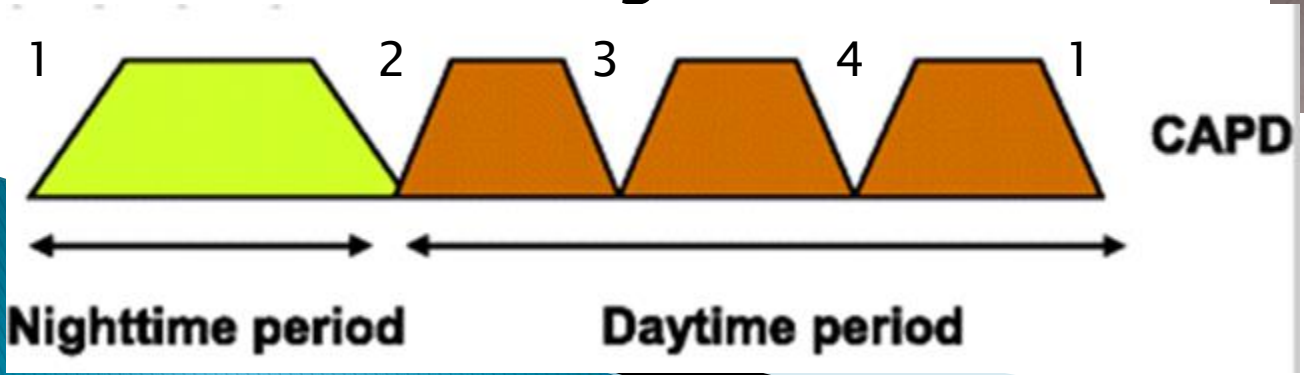
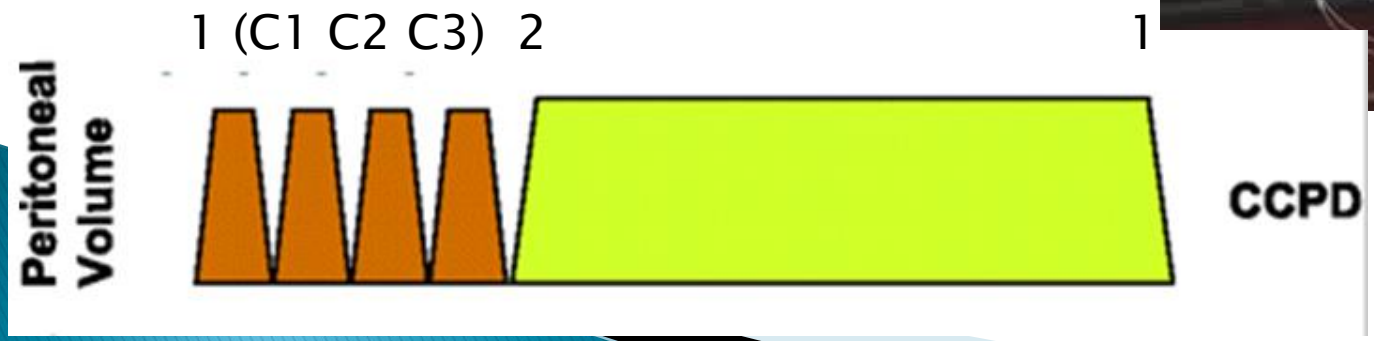


Photo: Beaumont Hospital

CCPD Rx

- Time on cycler: 8-10 hours
- Exchanges: 4-5 on cycler
  - Average dwell time ~2 hours
  - Not including time for draining/filling
- Fill volume: 2-3L
- Dialysate: 1.5%, 2.5%
  - Cycler keeps track of UF
- Day Dwell



Adjusting Rx– Clearance

- Poor Clearance, Dropping Kt/V
- Cause: Drop in RRF
- Tactics:
  - Increase fill volume
  - Add an exchange (overnight on cycler or midday)

Adjusting Rx- Volume

- Poor UF, Volume Overload
- Causes:
  - Drop in RRF
  - Increased salt and fluid intake
  - Suboptimal Rx
- Tactics:
  - Increase dextrose content of dialysate
  - Icodextrin
  - Diuretics
  - Rapid TP- shorten dwell times, add exchanges
  - Slow TP- difficult to tx

Complications of PD

- Infectious
  - Peritonitis
    Exit site infections
- Noninfectious
  - Pain
  - Filling/Draining Issues
  - Hernias
  - Hemoperitoneum

Peritonitis

- Complications
  - Hospitalization
  - Peritoneal Membrane Damage
  - Catheter loss/ Switch to HD
- Sources of infection
  - Touch contamination
  - Extension from exit site/tunnel infection
  - Bowel migration
- Risk factors
  - CAPD vs APD
  - Compromised host defenses (sugars, mesothelial spread)

Peritonitis- Prevention

- Training/ Home Visits
- Prophylaxis around procedures
  - Drain belly before all abdominal procedures
  - Dental ppx
- Aggressive tx of all exit site/tunnel infections

Normal PD Cath Exit Site

Photo: Endovascular Today

PD Exit Site/Tunnel Infection

-Erythema
-Crusting
-Granulation Tissue
-Pus on expression

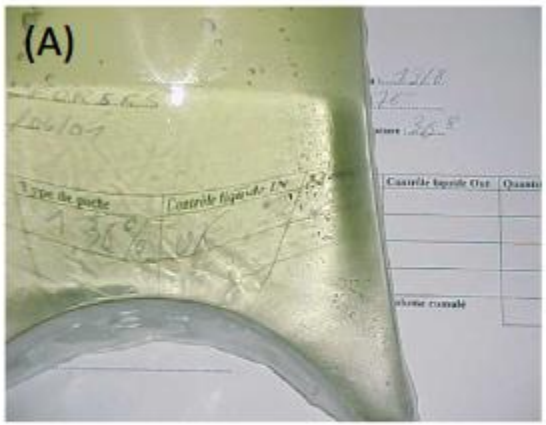
-Erythema over tunnel site
-Swollen
-Tender
-Pus on expression
-US can diagnose abscess

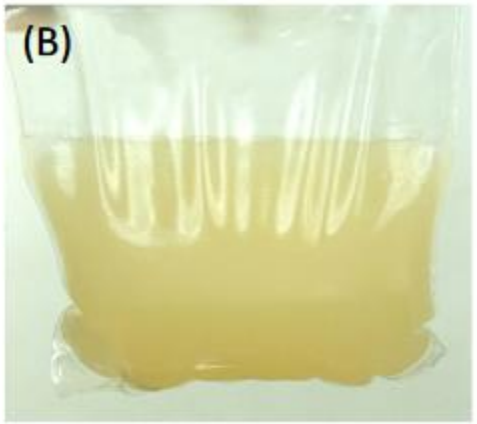
Exit Site/ Tunnel Infections- TX

- Usual care: topical Abx (gent or mupirocin)
- PO Abx- 1st generation cephalosporin
  - >/= 2 weeks
- Consider broader coverage (anti-PSA etc)
- Surgical evaluation
  - If no subsequent peritonitis, can do simultaneous replacement of catheter on other side

Peritonitis- clinical manifestations

- Abdominal Pain*
- Fever
- N/V
- Cloudy PD effluent*
- Hypotension/Sepsis (rare)





Wiley-seminars in dialysis

FIGURE 3 Cloudy dialysate. A, Normal CAPD effluent. It is clear enough to allow a text to be read through the dialysate bag. B, Effluent of 47-year-old man with end-stage renal failure secondary to Alport's syndrome admitted with acute peritonitis (white cell count : 7860/μL; 93% of polymorphonuclear neutrophils)

Peritonitis- Diagnosis

- Obtain PD fluid for cell count, gram stain, culture, and sensitivities
- WBCS > 100
  - >50% PMNs
- Positive Gram Stain/ Cx
  - Usually Gram+ (Staph Epi, Strep, S Aureus, Enterococcus)
  - Can be Gram – (E Coli, Klebsiella, Pseudomonas)
  - Rarely fungal

Peritonitis- Treatment

- Empiric Tx
  - Treat Gram + and – (Vanc/Ancef + Cefipime/Ceftaz)
- Definitive Tx
  - Once Pos. Culture returns- taper Abx
  - 20-40% Cx negative- keep dual coverage
- IP Dosing!
  - Preferred over IV unless pt septic
  - Intermittently in long dwell *or* continuously

Monitoring

- Monitor Abdominal Sx and cloudiness of effluent
- Repeat cell count/ Cx serially
- Antifungal PPX?
- Adjust Rx- transient high transport status
- Watch exit site

When to remove the catheter

- REFRACTORY- no improvement in symptoms/ cell counts after 5 days
- RELAPSING- same organism causes peritonitis again less than 4 weeks after Abx course
- FUNGAL- automatic removal
- INTRABDOMINAL PATHOLOGY- perf, abscess, etc

- HD x at least 3-4 weeks before PD catheter can be replaced

Common noninfectious PD issues

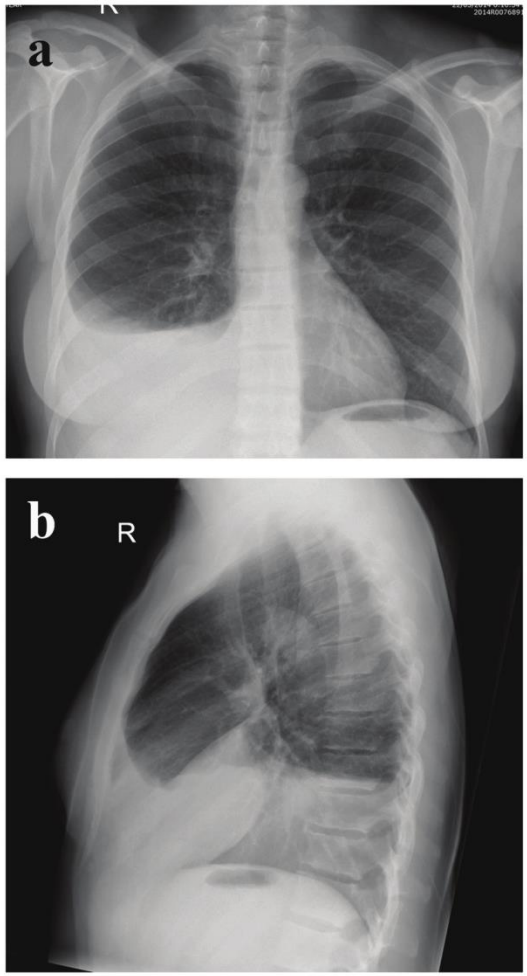
- Bloody dialysate
- Pleural effusions
- Dwell pain
- Catheter wont drain
- Hernias

Hemoperitoneum

- Menses
- SP PD cath insertion
- ADPKD cyst rupture

Pleural Effusion

- Pleuroperitoneal communication
- R > L
- Dx- confirm dialysate in pleural space
  - Creatinine, glucose etc
- Tx- Adjust PD Rx, Switch to HD, talc pleurodesis



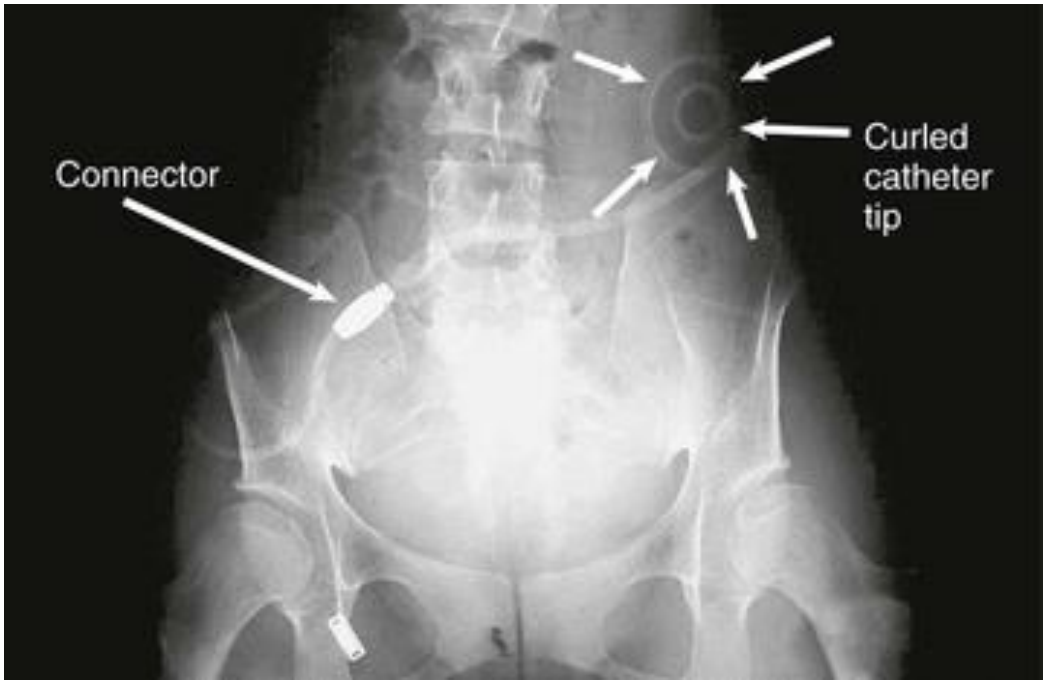
Dwell Pain (non-infectious)

- Common and transient
- Acidic pH of dialysate
- Poor catheter positioning
  - Wrapped in omentum, near bowel
- High glucose content

- Things to try:
  - Inject bicarb into fluid
  - Tidal Rx
  - Catheter manipulation/replacement

PD Catheter Outflow Failure

- CONSTIPATION
- Catheter malpositioning
- Catheter occlusion
  - Intraluminal
  - Extraluminal
- Catheter kinking



Outflow Failure– Mgmt

- Laxatives
- Heparin mixed into PD fluid if fibrin
  - TPA?
- Catheter manipulation/repositioning
  - Fluoroscopic
    - Stiff wire manipulation
  - Surgical
    - Redirection
    - Omentectomy
    - Replacement

Summary

- Peritoneal dialysis is still relatively uncommon in the US but incidence of home therapies is growing
- Despite many potential infectious and noninfectious complications, PD allows patients to live more independently outside the confines of the dialysis clinic.

Thank you!

- Questions?
- Comments?