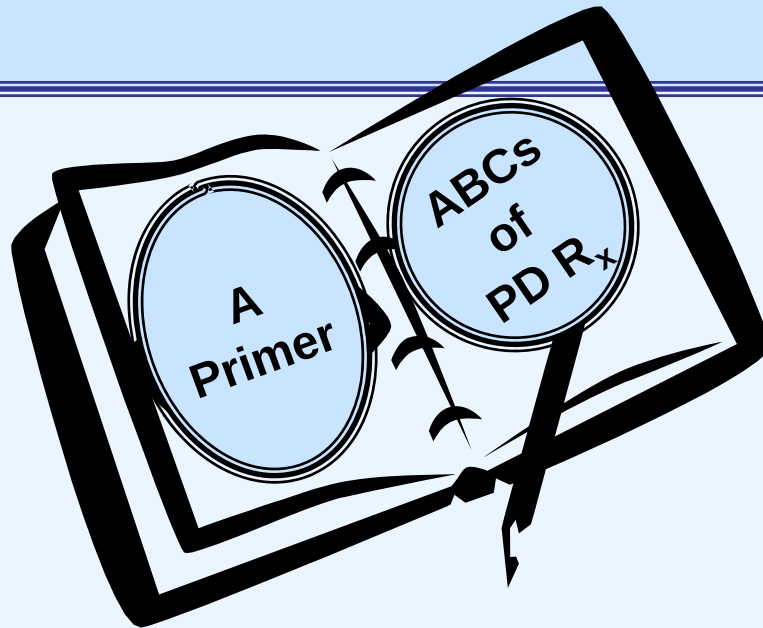


Peritoneal Dialysis Prescriptions: A Primer for Nurses

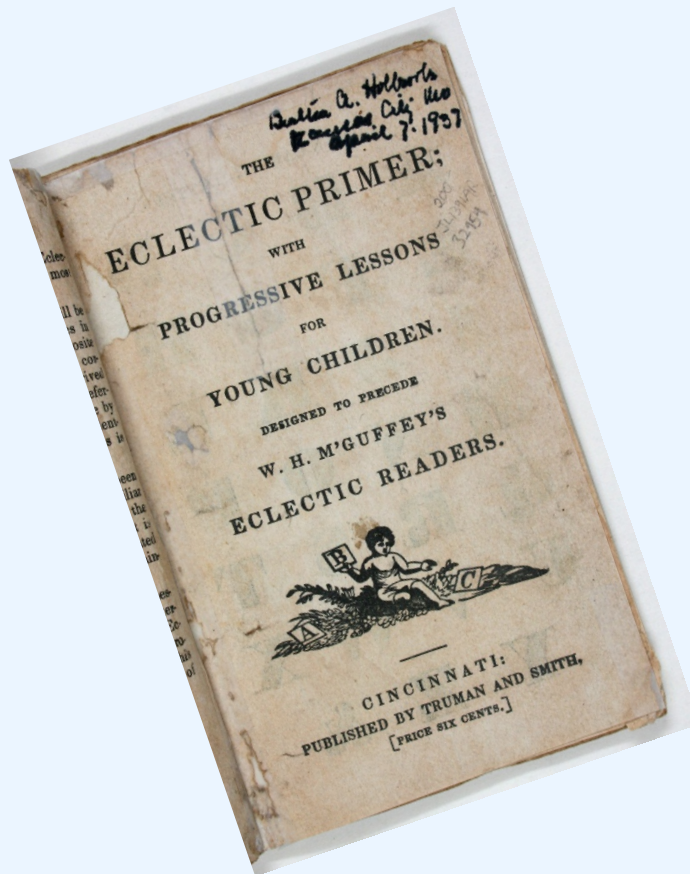


***Betty Kelman* RN-EC MEd CNeph (C)**
Toronto General Hospital University Health Network
Toronto, Ontario, Canada

A moment to remember



What is a Primer?



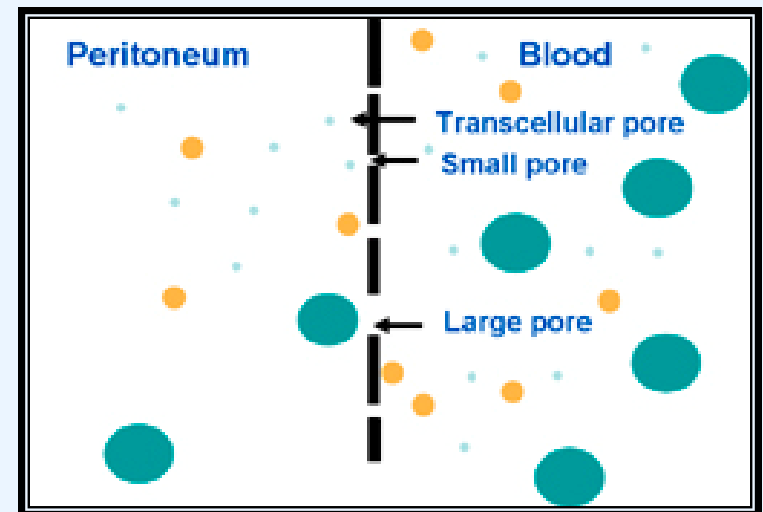


Objectives

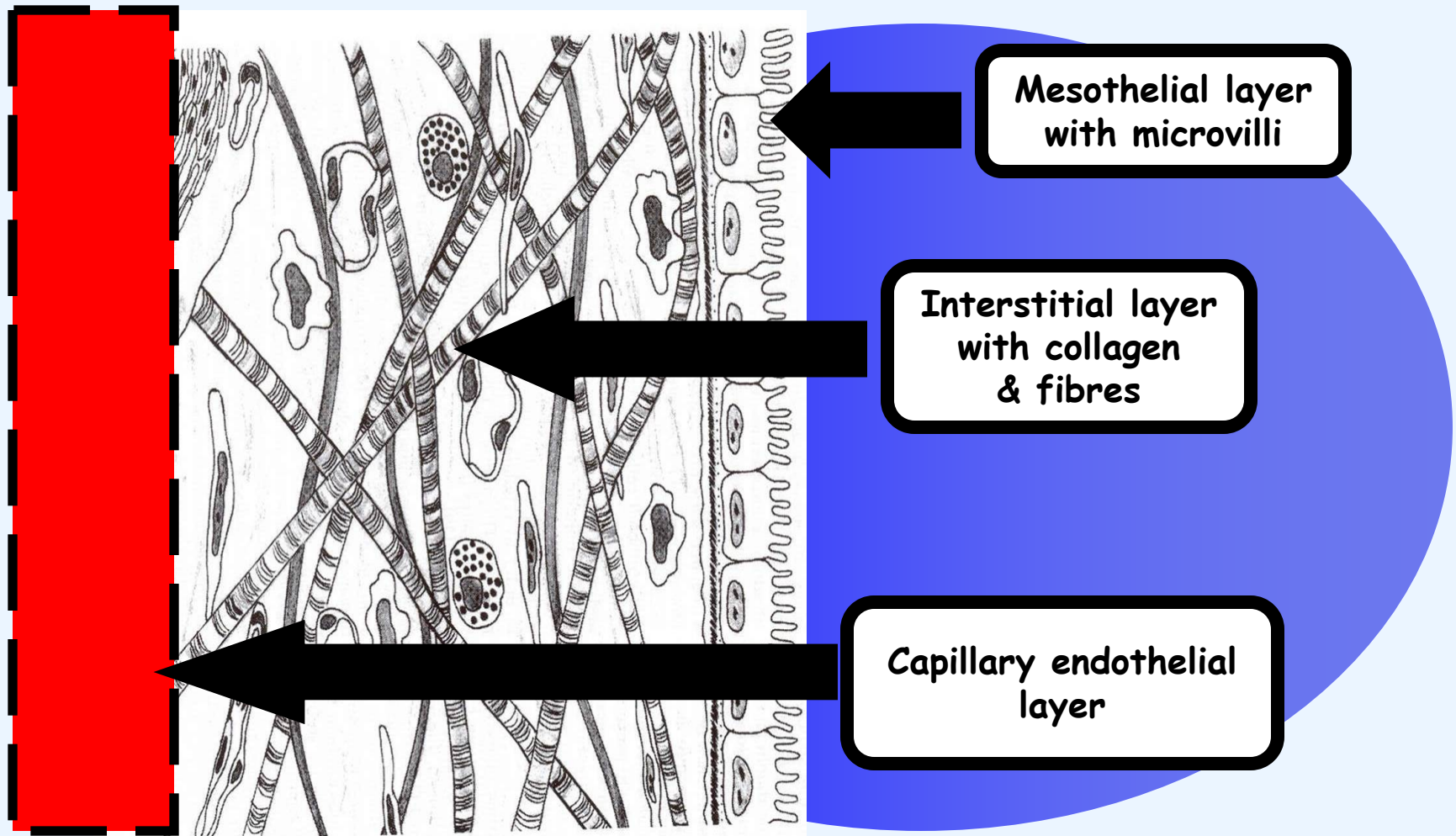
- a) Discuss the basics of peritoneal dialysis (PD) prescriptions**
- b) Relate membrane function to PD prescriptions**
- c) Discuss approaches for adjusting to individual differences in patients**

Basics of transport in peritoneal membrane

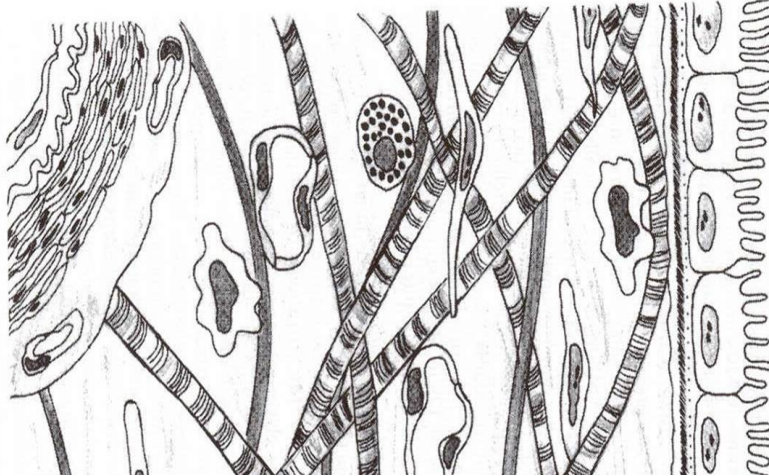
- a) Membrane structure**
- b) Transport of solutes**
- c) Transport of water**



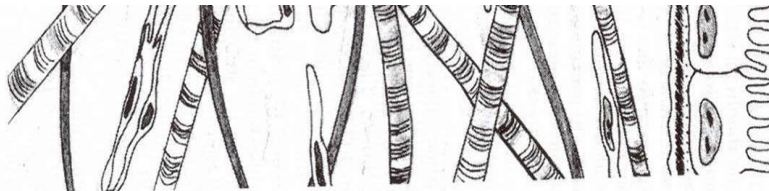
The Peritoneal Membrane



The Peritoneal Membrane: Effective Dialyzing Surface

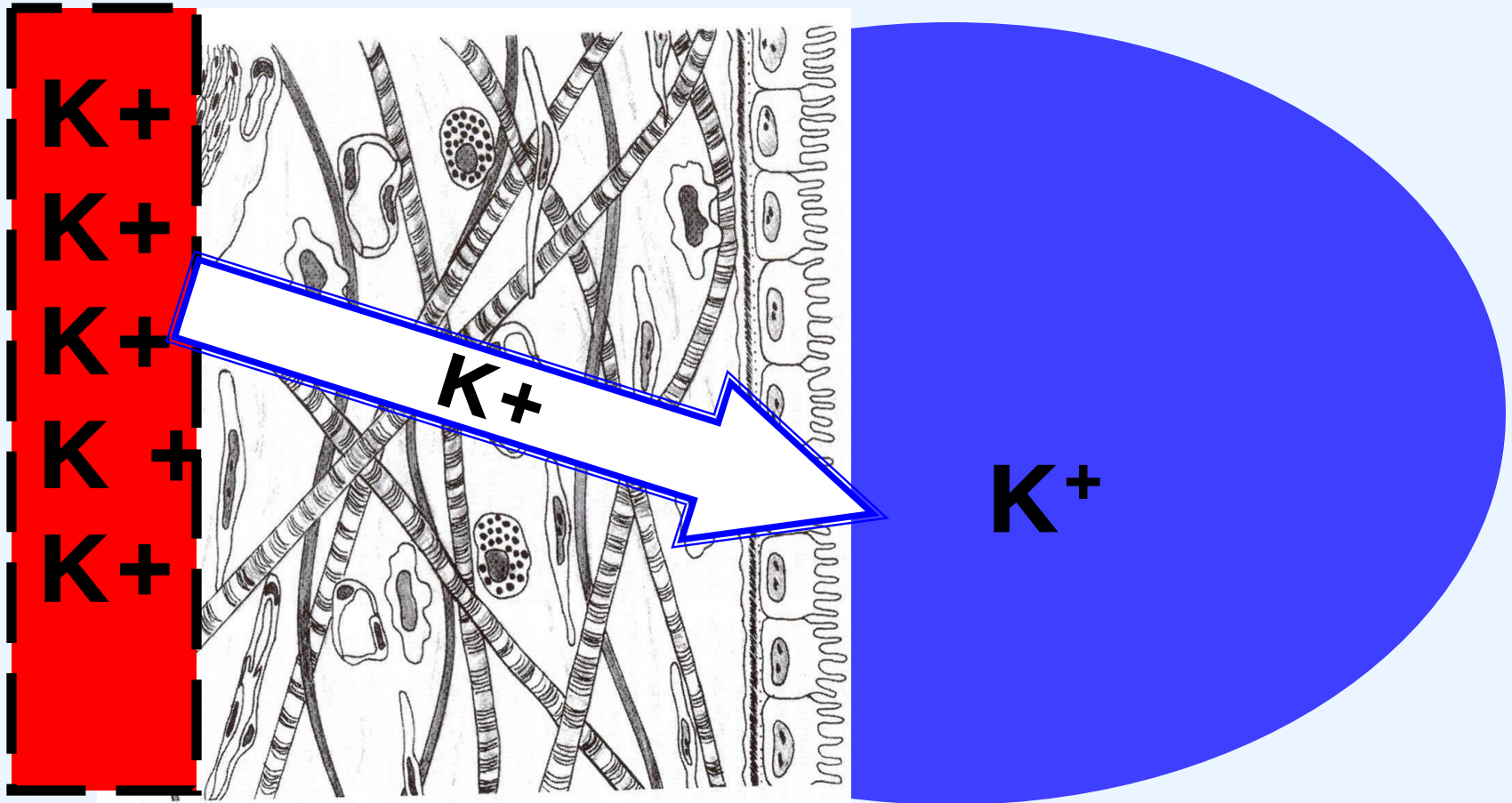


- # of perfused capillaries
- functional area for exchange between blood & dialysate



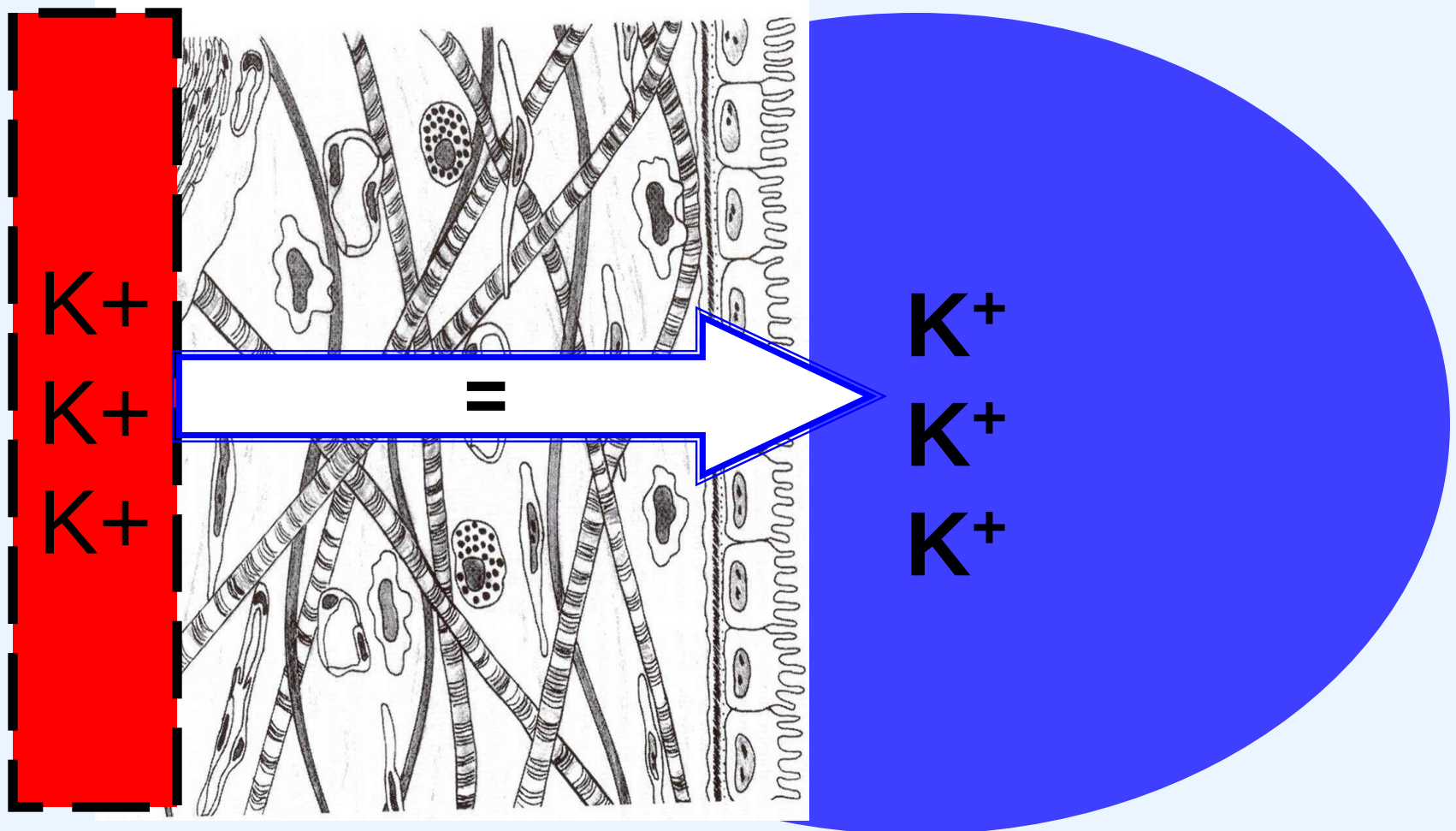
Diffusion

Solute: High to Low



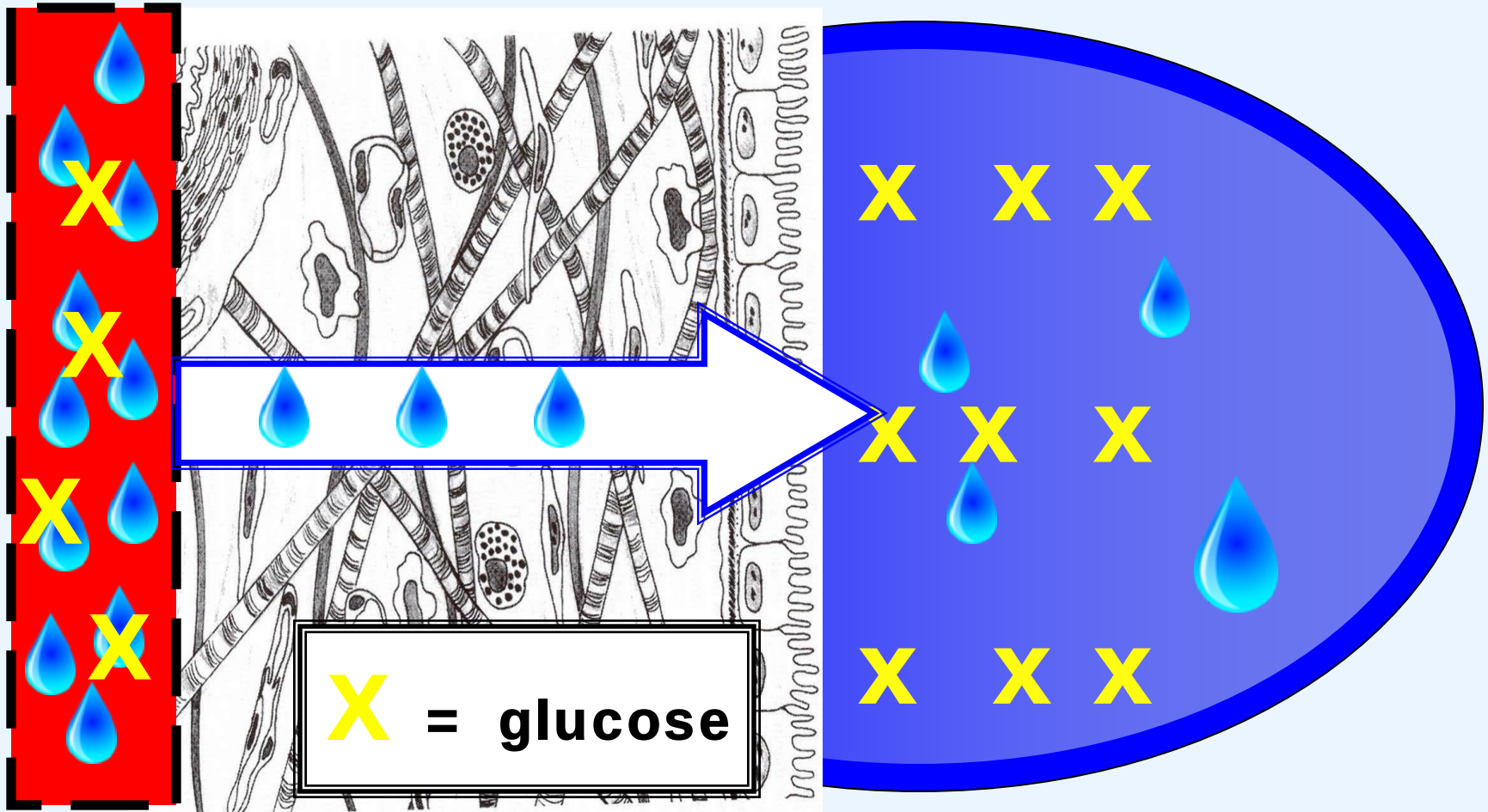
Diffusion

Eventually reach equilibrium

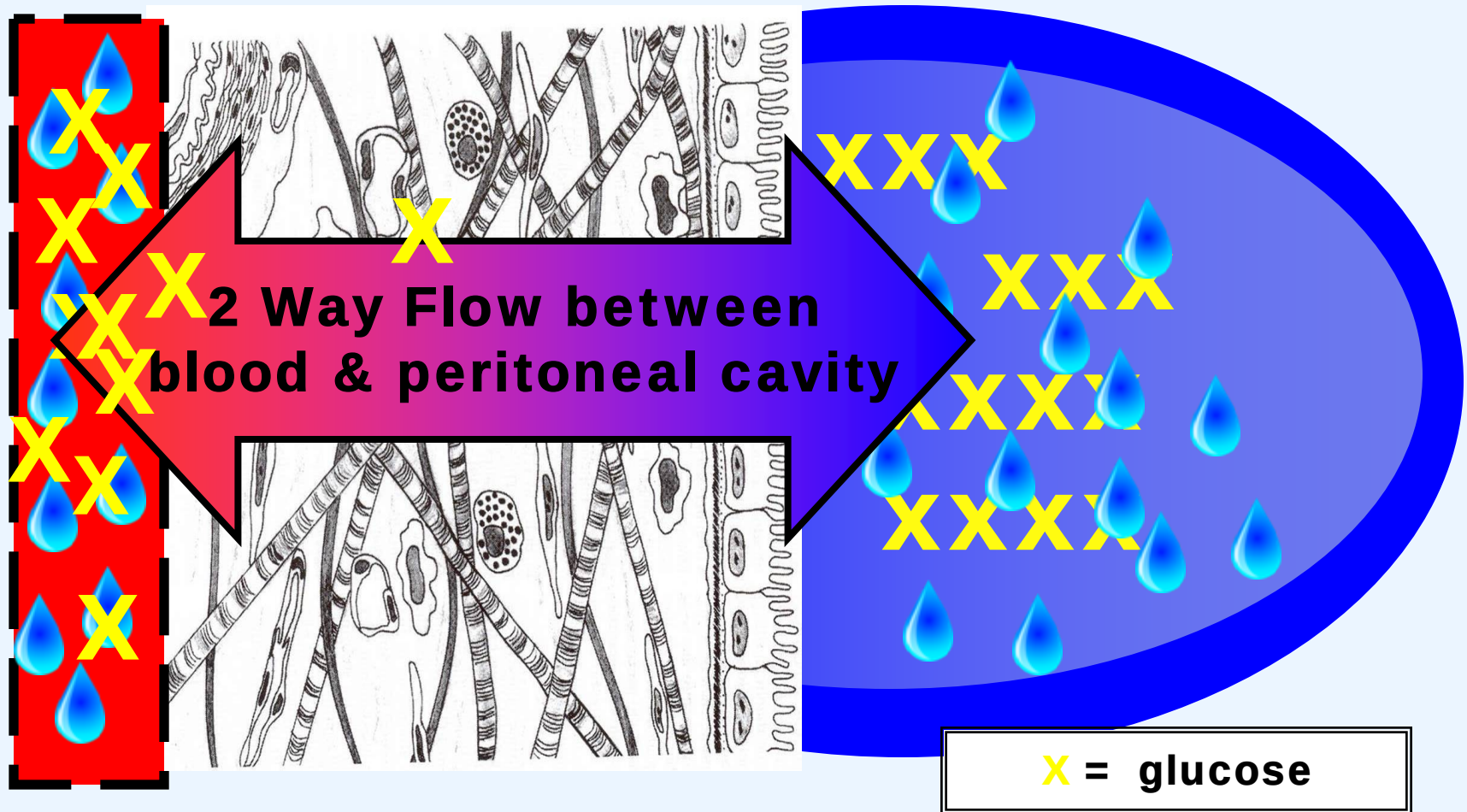


Osmosis

movement of solvent from
low solute to high solute concentration



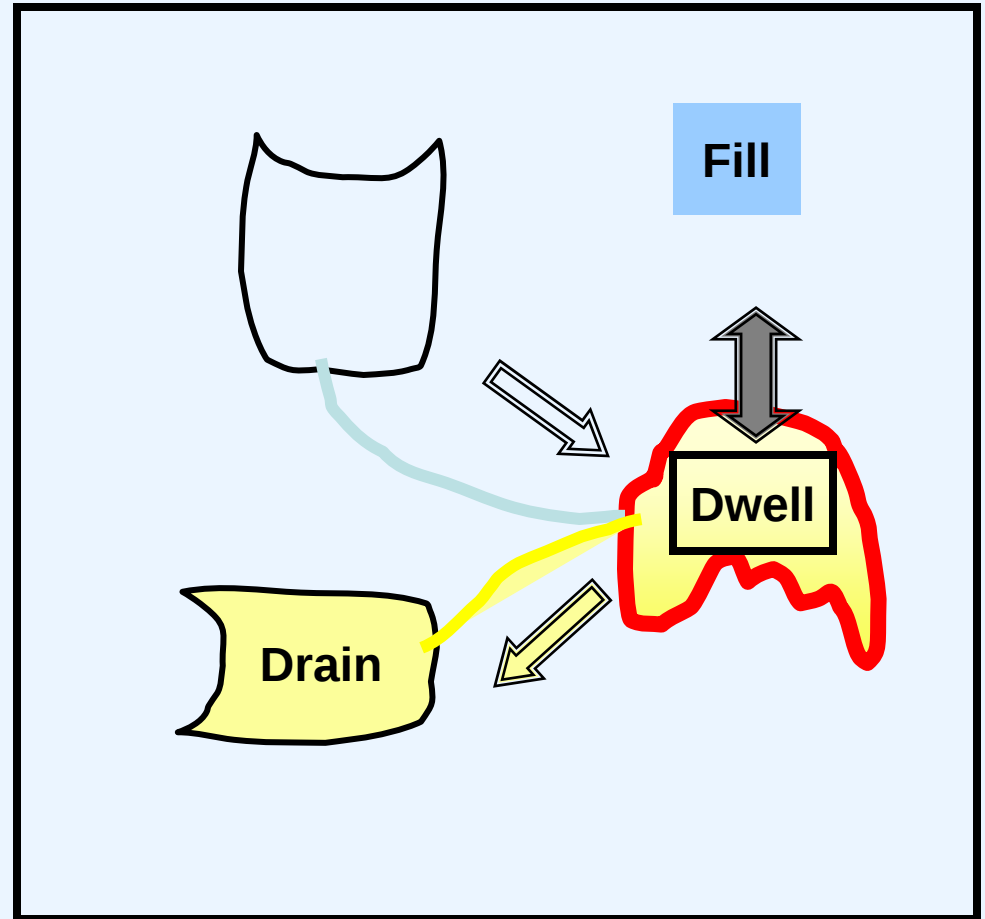
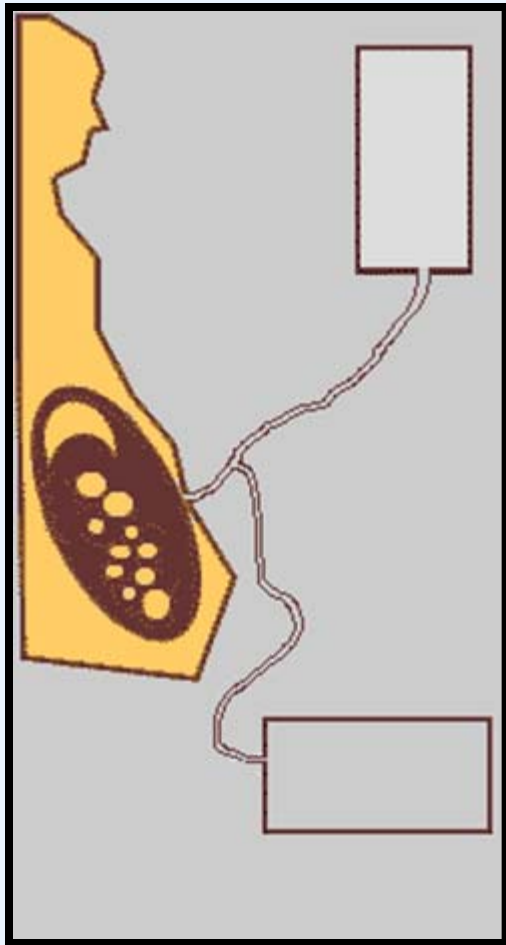
But Two Way Flow



Principles of Transport

If *glucose* is *absorbed* into the *blood*, then *less glucose* is available for *osmotic pressure* for *water removal* in the peritoneal cavity!

Peritoneal Dialysis Simplified



Basic Elements of Prescription

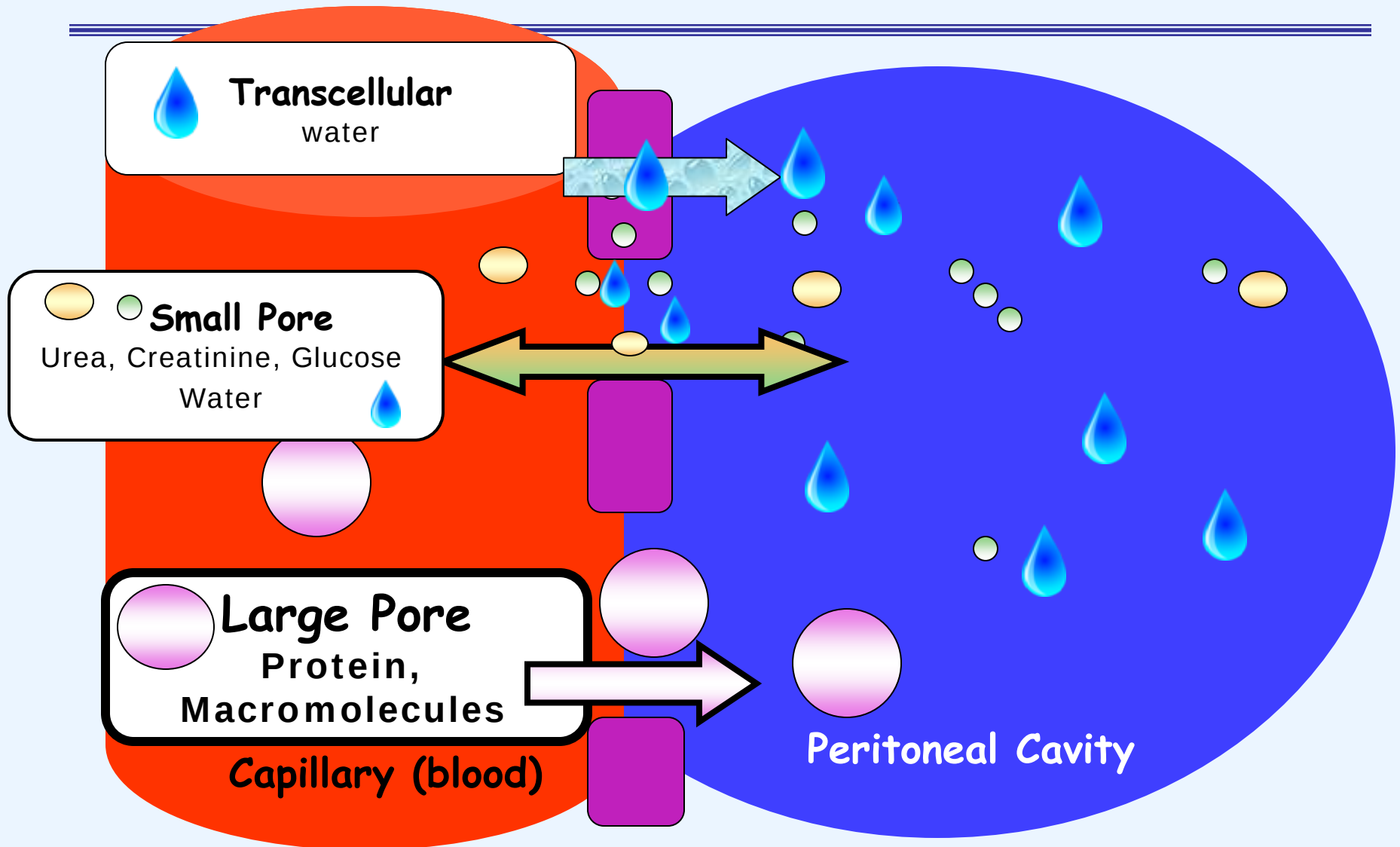
What is an exchange?

- a) Fill**
- b) Dwell**
- c) Drain**

Basics of dialysis goals

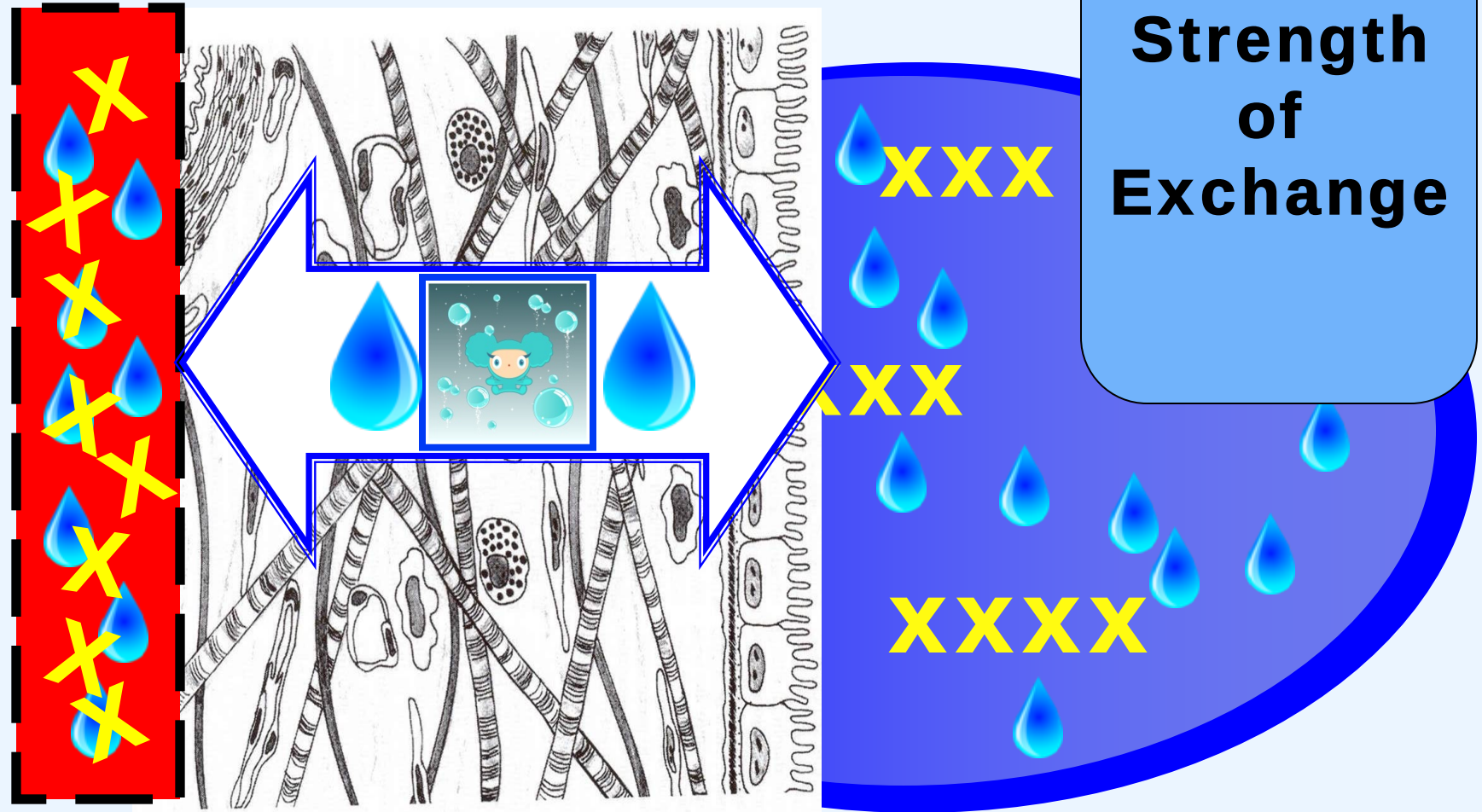
- a) Removal of solutes**
- b) Removal of fluid (ultrafiltration)**
- c) Patient survival**
- d) Patient quality of life**

3 Pore Model





Ultrafiltration



Standard PD Solutions

Strength of Solution (%)	Osmolarity (mOsm/L)	Effect (60 min dwell time)
0.5	296	Less return
1.5	346	50 – 150 mL
2.5	396	100 – 300 mL
4.25	485	300 – 400 mL

Peritoneal Dialysis Solutions

- **Dextrose Solutions**
- **Icodextrin (ExtranealTM)**
 - **Starch-derived glucose polymer**
 - **Maintains osmotic gradient with long dwell**
 - **282-286 mOsm/L**
 - **MW 13,000-19,000 Daltons with long dwell**
 - **8 – 12 hours**

Prescriptions

- **Exchange volume**
- **Type of PD**
- **Duration of Therapy**
- **Intraperitoneal medications**
- **Target weight**
 - **Bag strengths**
 - **U/f goals**

Volume & Effective Dialyzing Surface



**Volume
of
Exchange**

- # of perfused capillaries
- functional area for exchange between blood & dialysate

What is the right volume?

- **And the answer is that depends!!**
 - **Body size**
 - **Break-in techniques**
 - **Adjusting for complications**
 - **Hernias**
 - **Back pain**
 - **Post-surgery**
 - **Peritonitis**

Type of PD

- **Intermittent Peritoneal Dialysis (IPD)**
- **Continuous ambulatory PD (CAPD)**
- **Automated PD (APD)**
 - **CCPD**
 - **CCPD – enhanced**
 - **NIPD**
 - **TVPD**

Solute Clearance & Flow Rate

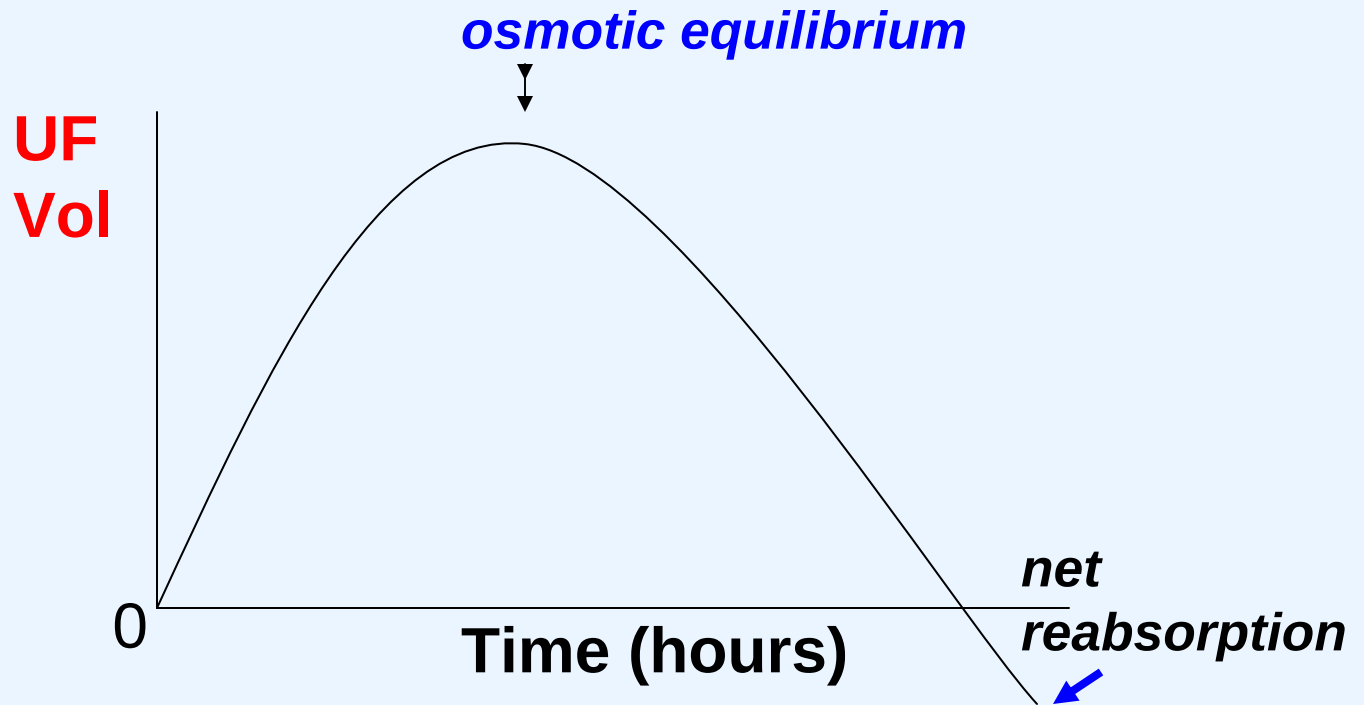
Since patients could not tolerate a flow rate of 6 litres/hr, we conclude that a flow rate of 4 litres/hr with a 2-litre exchange will give maximum efficiency.

Robson, M., Oreopoulos, DG., Izatt, S., Ogilvie, R., Rapoport, A., deVeber, GA. (1978) Influence of exchange volume & dialysate flow rate on solute clearance in peritoneal dialysis *Kidney Int* 14(5) 486-90.

What does 4 L/hour mean?

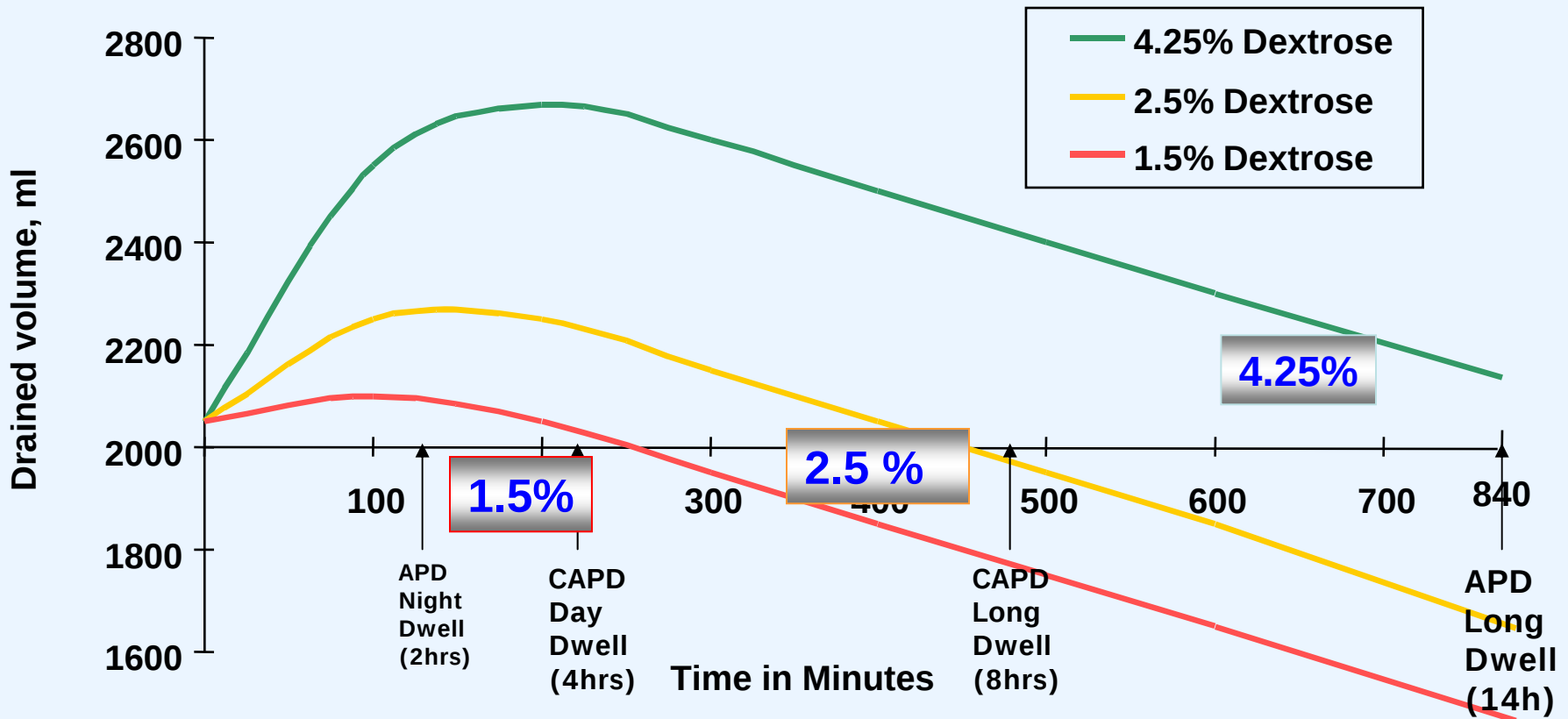
- **3 L/hr vs 4 L/hr vs 6 L/hr**
- **4 litres per hour**
 - **2 litre exchange q30 minutes**
 - **Fill** **10 minutes**
 - **Dwell** **10 minutes**
 - **Drain** **10 minutes**

Loss of Osmotic Gradient During a Long PD Dwell



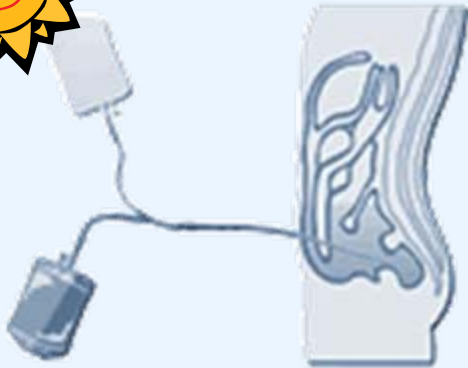
(courtesy J. Bargman)

Typical Ultrafiltration Curves for Each Strength of Dialysate



(courtesy J. Bargman)

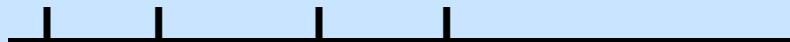
CAPD vs APD



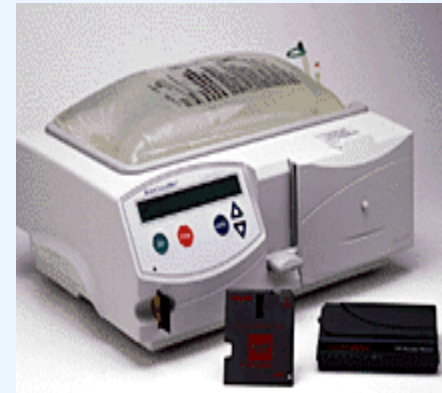
CAPD

AM

PM



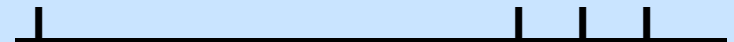
(4 exchanges: 3 day; 1 overnight)



APD (i.e. CCPD)

AM

PM



(4 exchanges: 3 overnight, 1 day)

Prescription: CAPD

- **2 litres QID**
 - **Exchanges at 0800, 1200, 1800 and 2200**
 - **2 x 4 hour dwell**
 - **1 x 6 hour dwell**
 - **1 x 10 hour dwell**

- **Target weight**
 - **65 kg (full)**

Assessing response

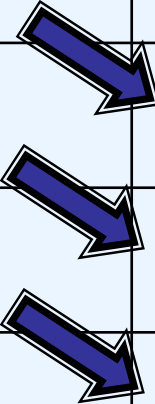
Time	Strength %	Volume infused (mL)	Volume drained (mL)	Balance (mL)
0800	1.5	2000		
1200	1.5	2000	2200	-200
1800	1.5	2000	2100	-100
2200	1.5	2000	2250	-250
0800	1.5	2000	1600	+400

Assessing response

Strength	Volume infused (mL)	Volume drained (mL)	Balance (mL)	Cumulative u/f (mL)
4.25%	2000			
2.5%	2000	2700	-700	-700
4.25%	2000	2300	-300	-1000
2.5%	2000	2650	-650	-1650
4.25%	2000	2350	-350	-2000

Diminishing returns

Strength %	Volume infused (mL)	Volume drained (mL)
2.5	2000	
2.5	2000	1600
4.25	2000	1200
2.5	2000	1400



Prescription: CCPD

- **Total Volume 8 litres**
 - **3 exchanges of 2 litre overnight for 10 hours**
 - **Last fill of 2 litres**
- **Target weight**
 - **65 kg (full)**

CCPD (2 litre) x 10 hours

What does this mean?

- **If do 3 exchanges 10 hours overnight**
 - 10 hours x 60 = 600 minutes
 - $600 \div 3 = 200$ minutes
- **For each 2 litre exchange**
 - Fill = 10 minutes
 - Dwell = 170 minutes
 - Drain = 20 minutes
- **Last exchange (day dwell)**
 - 14 hours

Inflow rate	200 mL/min
Outflow rate	Variable
	Best 200 mL/min

CCPD – change to 8 hours

- **If do 3 exchanges 8 hours overnight**
 - 8 hours x 60 = 480 minutes
 - $480 \div 3 = 160$ minutes
- **For each 2 litre exchange**
 - Fill = 10 minutes
 - Dwell = 130 minutes
 - Drain = 20 minutes
- **Last Fill (day dwell)**
 - 16 hours

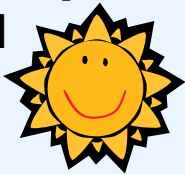
Inflow rate	200 mL/min
Outflow rate	Variable
	Best 200 mL/min

If absorbs with long dwell

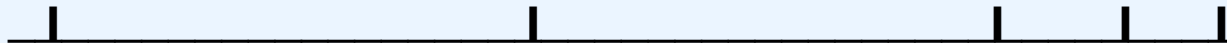
- May do CCPD – enhanced
- Use of additional exchange during day to reduce absorption

APD (i.e. CCPD enhanced)

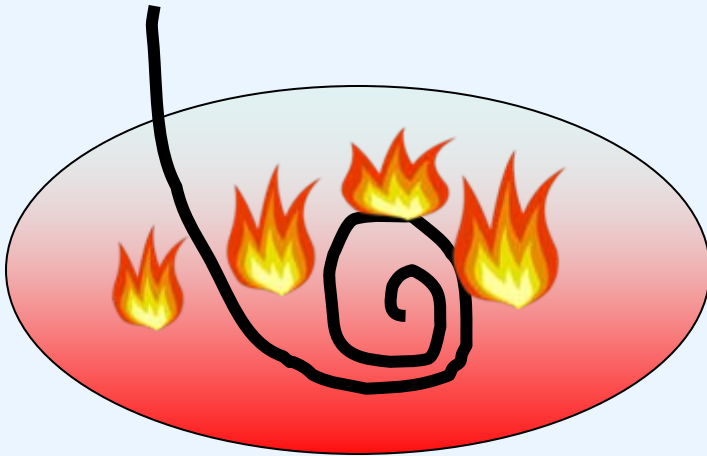
AM



PM



Dry Pain



Empty

- Pulling pain
- Worsens with peritonitis



Leave residual pool of fluid

- Float catheter

TVPD Prescription

- **Total Volume 6800 litres**
- **Tidal Volume 80%**
- **$2000 \times 80\% = 1600$**
- **First exchange – 2000 mL**
 - **Remaining exchanges – 1600 mL**

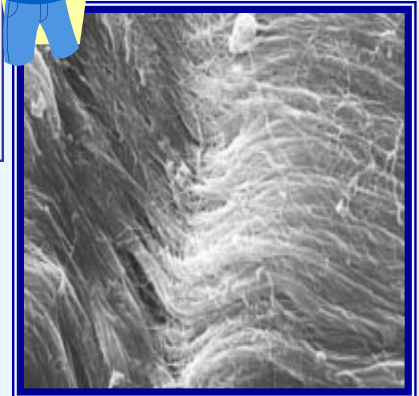
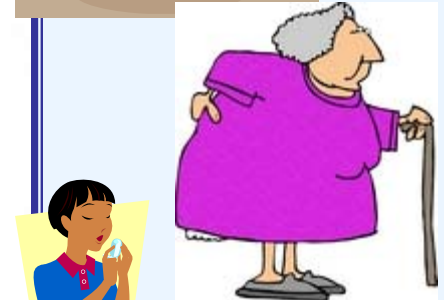
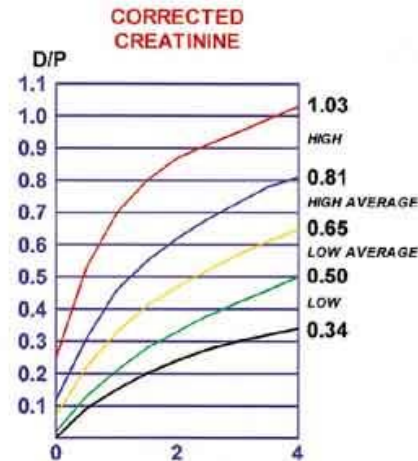
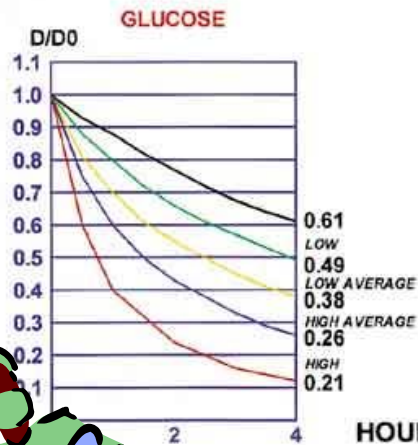
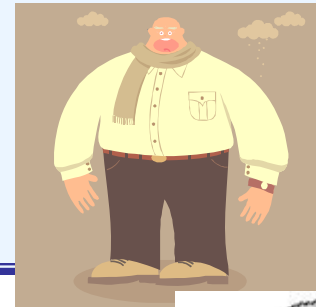
Exchange Volume (TVPD)

- **First exchange** = 2000 mL
 - **Second exchange** = 1600 mL
 - **Third exchange** = 1600 mL
 - **Fourth exchange** = 1600 mL
-
- **Total Volume** = 6800 mL

Additional Orders for TVPD

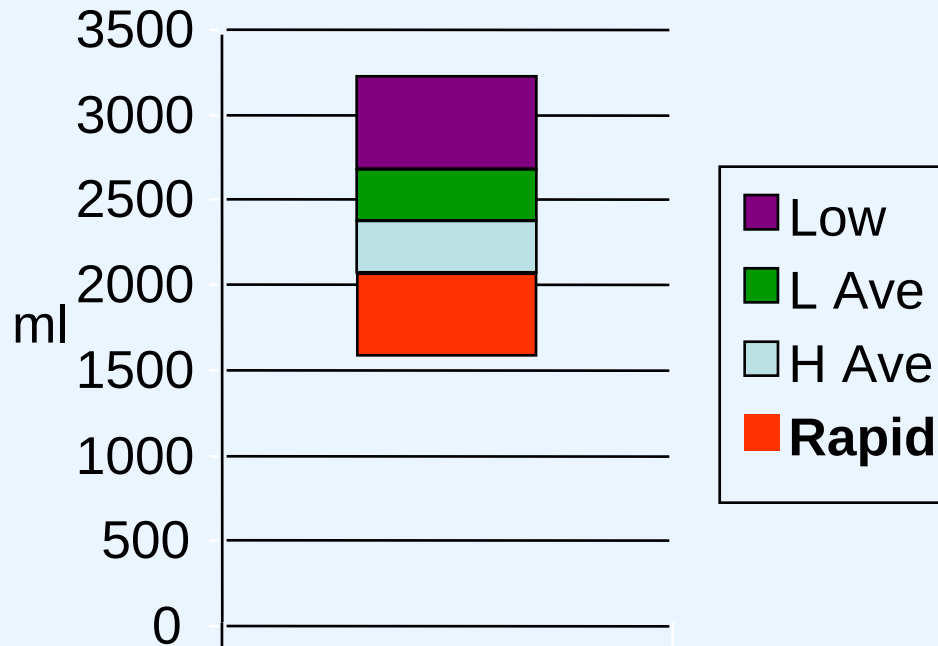
- **Manual drains as indicated**
 - **Drains completely as set**
 - **If small number of overnight exchanges, may not be effective in reducing dry pain**
- **Ultrafiltration volume**
 - **Estimated on first run**
 - **Avoid overfilling**

Not everyone is the same

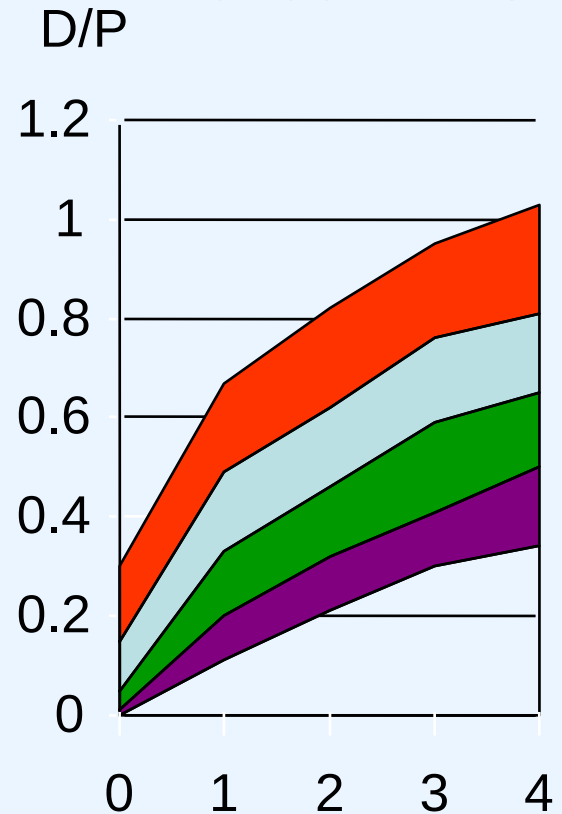


Peritoneal Equilibration Test

Drain Volume



Creatinine

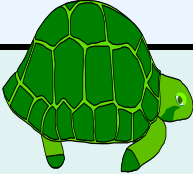


(courtesy J. Bargman)

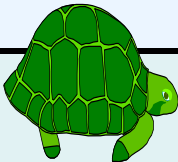
Transport Classification

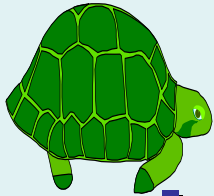
Classification	D/P Creatinine	Drain Volume (mL)
Rapid	0.82 - 1.03	1580 - 2084
Rapid average	0.66 - 0.81	2085 - 2367
Mean	0.65	2368
Low	0.50 - 0.64	2369 - 2650
Low average	0.34 - 0.49	2651 - 3362

Peritoneal Membrane Classification

Low 	Low Average	High Average	Rapid 
a) absorbs dextrose slowly b) maintains concentration gradient c) ↑fluid removal			a) absorbs dextrose rapidly b) loss of concentration gradient c) ↓fluid removal

Peritoneal Membrane Classification

Low 	Low Average	High Average	Rapid 
↑dwell time ■ enhance solute removal			↓dwell time ■ Maintain gradient for water removal
CAPD			CCPD/NIPD
Drain volume ■ 2651-3326 mL			Drain volume ■ 1580-2084 mL



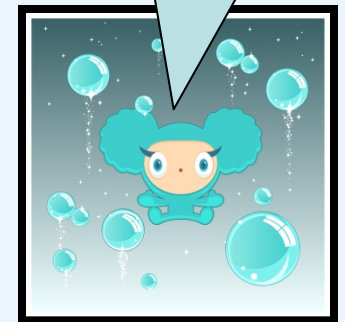
Applying the Results to the Individual



Mr. L.A.: on APD for lifestyle

- 2 years later, experiencing weight loss/nausea
- Reflux disease
- PET results show low average transport (0.49)

What change do you feel should be made for Mr. L.A.?



Transport characteristics

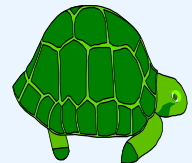
Low average 0.34 - 0.49 2651 – 3362 mL

Low Transporter

Long dwell periods

- ◆ *allow for solute clearance to occur over time*
- ◆ *enhanced middle molecule removal*

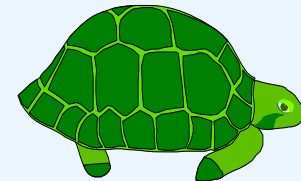
CAPD with or without night exchange



Mr. L.A.: on APD for lifestyle

CHANGE TO CAPD

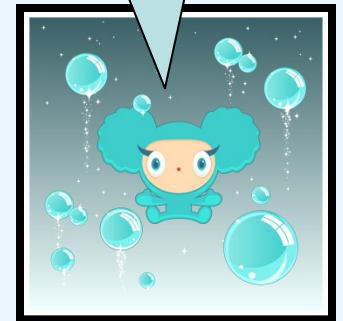
- a) Allow for longer dwell**
- b) Enhance clearances**



Mr. H.A.: on CAPD

- Poor fluid returns from exchanges
- Weight gain
- Short of breath
- PET results show rapid transport (0.91)

What change do you feel should be made for Mr. H.A.?



Transport characteristics

Rapid 0.82 - 1.03 1580 – 2084 mL

Rapid Transporter

**Frequent shorter
dwell periods**

- ***decrease glucose
absorption***
- ***enhance
ultrafiltration***



- a) APD with dry day**
- b) APD with added
day exchanges**
- c) CAPD with night
exchanges**

Mr. H.A.: on CAPD

CHANGE TO CCPD

- a) shorter dwell times**
- b) decreased glucose absorption**
- c) improved fluid removal**



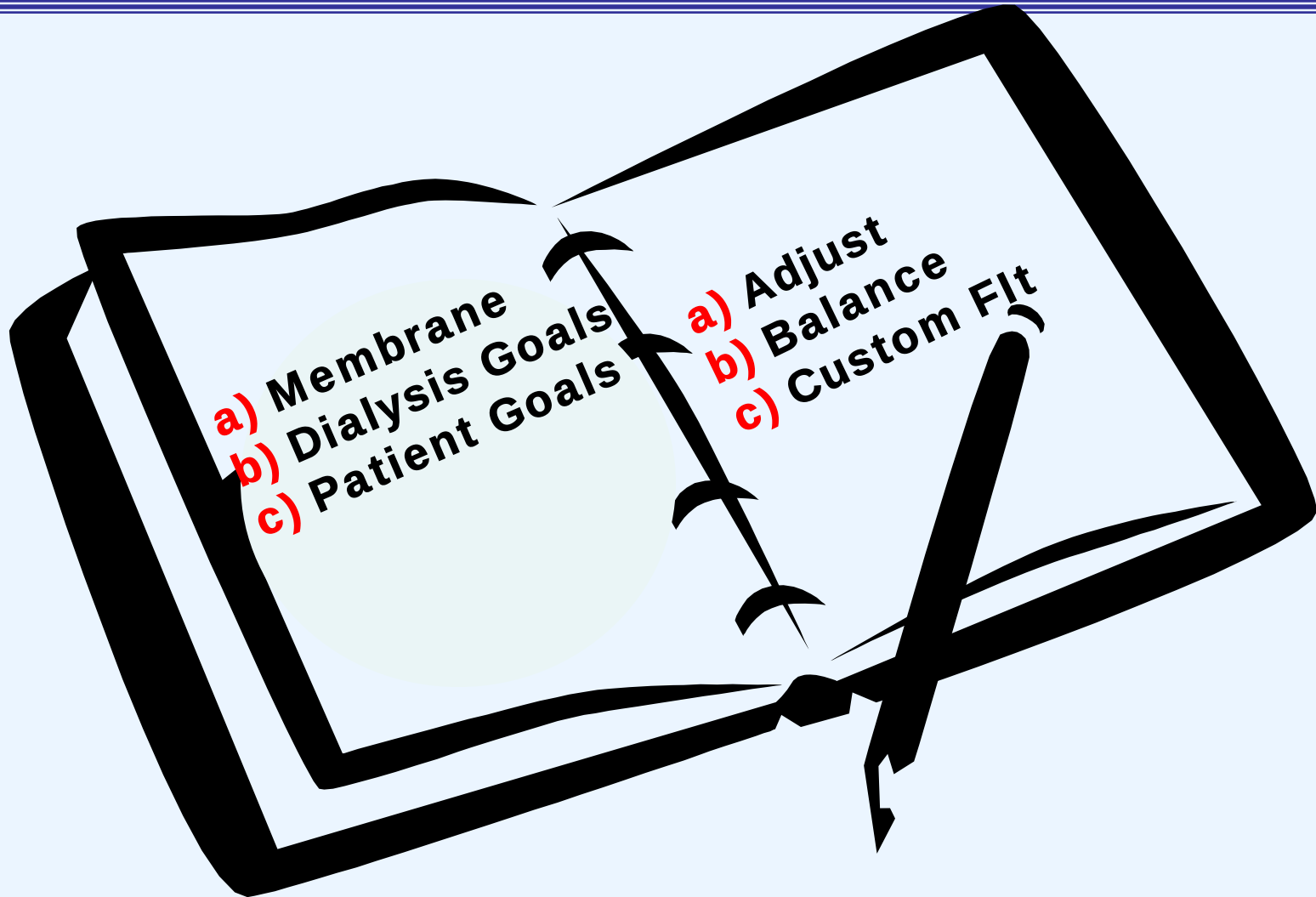
Mr. D.P.

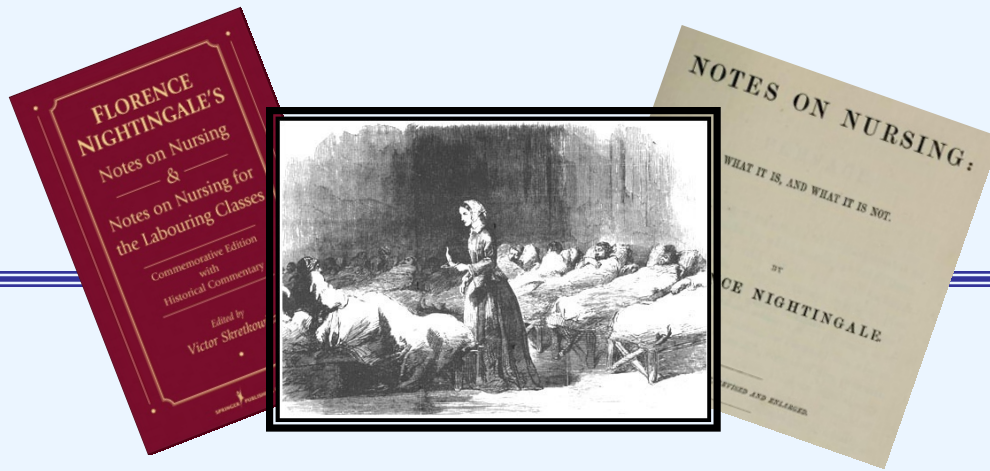
- **Radiological insertion of peritoneal catheter**
- **Flushes well**
- **IPD for break-in**
 - **First and second – pain on outflow**
 - **Third – decreased pain, tolerable**
 - **Fourth – pain on outflow, lower abdomen, radiating to penis**

Mr. D.P.

- **Assess**
 - **No pain when not dialyzing**
 - **Bowel movements – 2/day**
- **Adjust for tidal volume**
- **Bypass initial drain**
- **Bowel routine**
- **Consider changing to CAPD for initial training period**

Primer on PD Prescriptions: A Beginning





**“The art is that of nursing the sick,
please mark, not nursing sickness.
This is why nursing proper can only be
taught at the patient’s bedside and in
the sickroom or wards. Lectures and
books are but valuable accessories.”**

Florence Nightingale