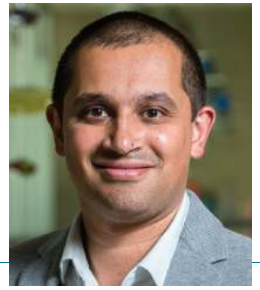
Dry Weight Assessment: A Multi-Disciplinary Approach

Dr. Cherry Mammen
Pediatric Nephrologist

Kirsten McFadyen, RD
Renal Dietitian



BC Children's Hospital
Division of Nephrology
Vancouver, BC, Canada

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Disclosures

No financial support or conflict of interests to report

Objectives

- Discuss Na^+/fluid removal mechanisms & strategies in dialysis patients to help maintain "dry weight"
- Discuss various tools to determine "dry weight" in our chronic pediatric PD & HD patients from a multi-disciplinary perspective
- Reveal "dry weight challenges" through 2 dialysis cases from our institution

It Takes a Village

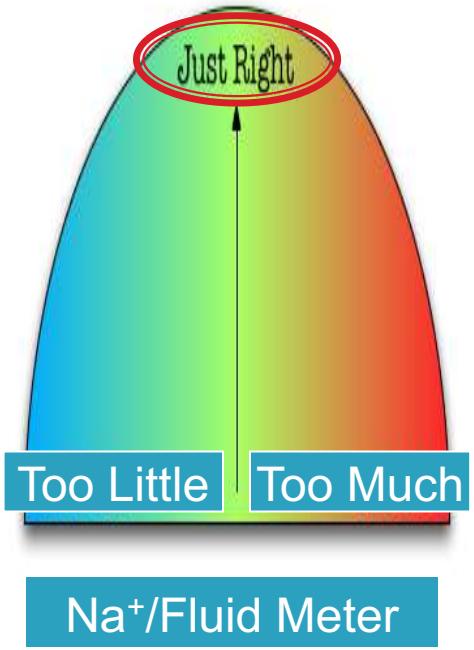
Nephrologist

HD Nurses

Dietitians

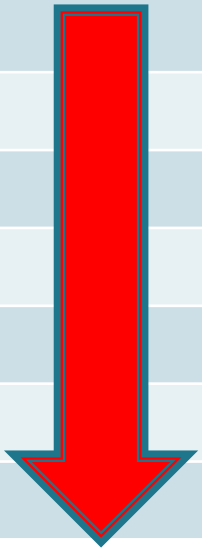
PD Nurses

Our vision of “dry weight”



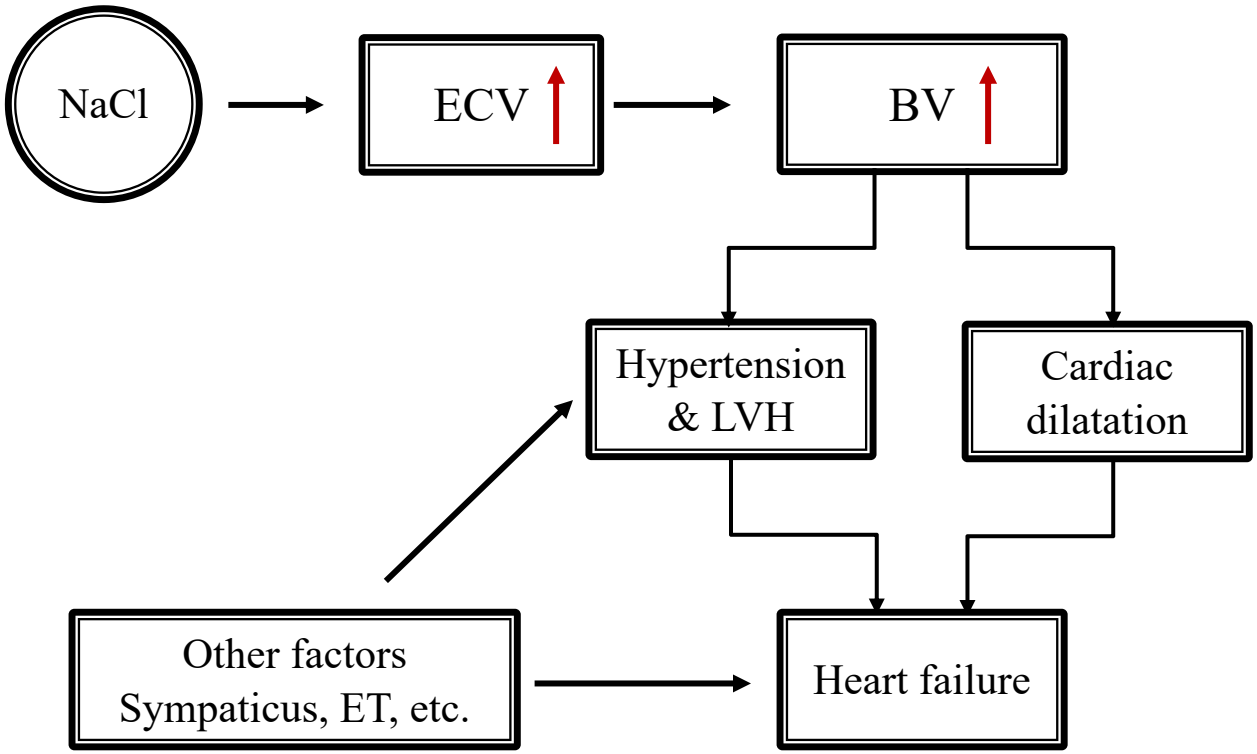
Why are our dialysis patients at risk of "too much" on the fluid meter?

GFR (ml/min)	Filtered Na^+ (mmol/min)	Filtered Na^+ (mmol/day)	Max excreted Na (grams/day)
120	16.8	24.2	27.7
90	12.6	18.1	20.8
60	8.4	12.1	13.8
45	6.3	9.1	10.4
30	4.2	6.0	6.9
15	2.1	3.0	3.5
10	1.4	2.0	2.3



**assuming a max fractional sodium excretion of 5%

Consequences of “too much”



(ECV: Extracellular volume, BV: Blood Volume, ET: Endothelin, LVH: Left Ventricular Hypertrophy)

Consequences of "too much"

- NAPRTCS: 57% of nearly 4000 patients on dialysis with BP >95th percentile
- European Ped RRT Registry: 35.5% of 851 PD & 45.5% of HD patients had BP >95th%ile irrespective of the use of anti-hypertensive medications
- IPPN: LVH prevalence of 48.1% of 507 pediatric dialysis patients from 55 centers

Mitsnefes M, Am J Kidney Dis 2005
Kramer AM, Kidney Int 2011
Bakkaloglu SA CJASN 2011

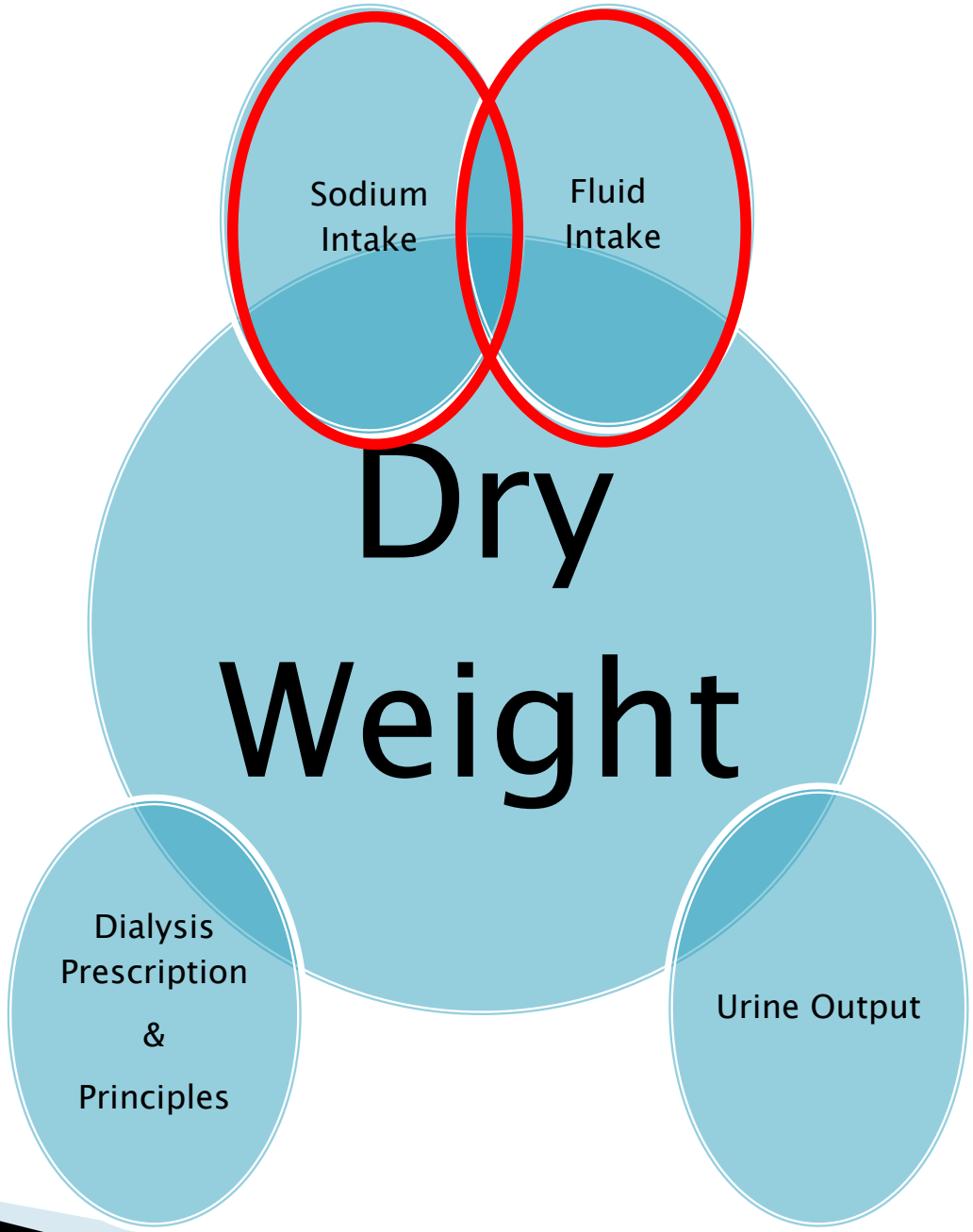
Consequences of “too little”

Inadequate nutrition & loss of weight
Patient/family fear of “probing” dry weight
Potential loss of residual renal function
Increased thirst

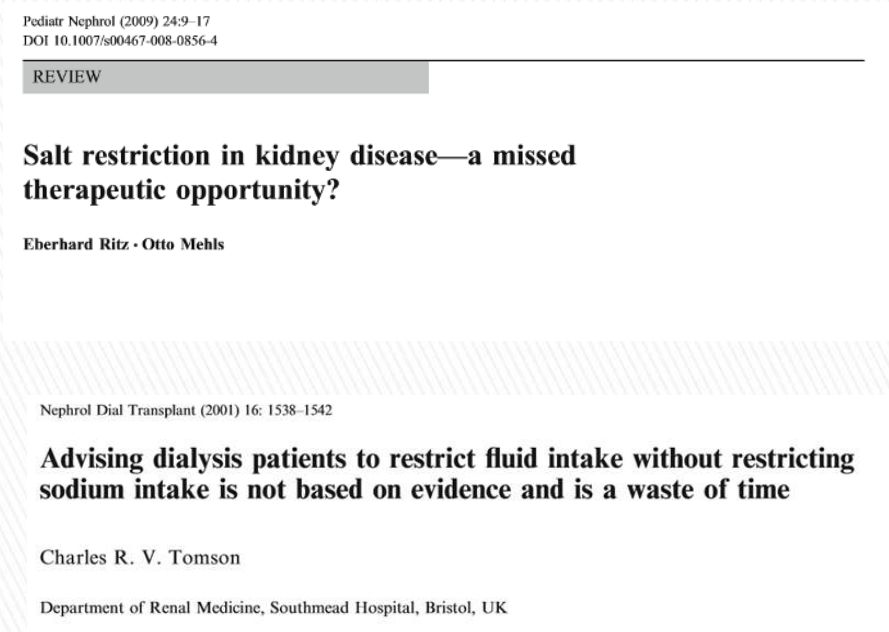
Fluid Overload

The barriers of finding goal weight

- “Goal weight” is a moving target!!!!!
- Adequate nutrition often means “more fluid”
- Patients often feel “well” when overhydrated
- Difficulties with patients restricting Na^+/fluid
- Difficulties with removing Na^+/fluid with dialysis


Sodium Intake
Fluid Intake
Dry Weight
Dialysis Prescription & Principles
Urine Output

Importance of Low Sodium Diet



Pediatr Nephrol (2009) 24:9–17
DOI 10.1007/s00467-008-0856-4

REVIEW

Salt restriction in kidney disease—a missed therapeutic opportunity?

Eberhard Ritz · Otto Mehls

Nephrol Dial Transplant (2001) 16: 1538–1542

Advising dialysis patients to restrict fluid intake without restricting sodium intake is not based on evidence and is a waste of time

Charles R. V. Tomson

Department of Renal Medicine, Southmead Hospital, Bristol, UK

"Advising dialysis patients to restrict fluid intake when they have not had advice on how to limit their salt intake is inhumane, because they are made to feel guilty and inadequate at being unable to restrict their fluid intake – and is a waste of time"

Tomson, Nephrol Dial Trans (2001)

Overview of Sodium Intake

- Children enter CKD without having adopted a low sodium diet

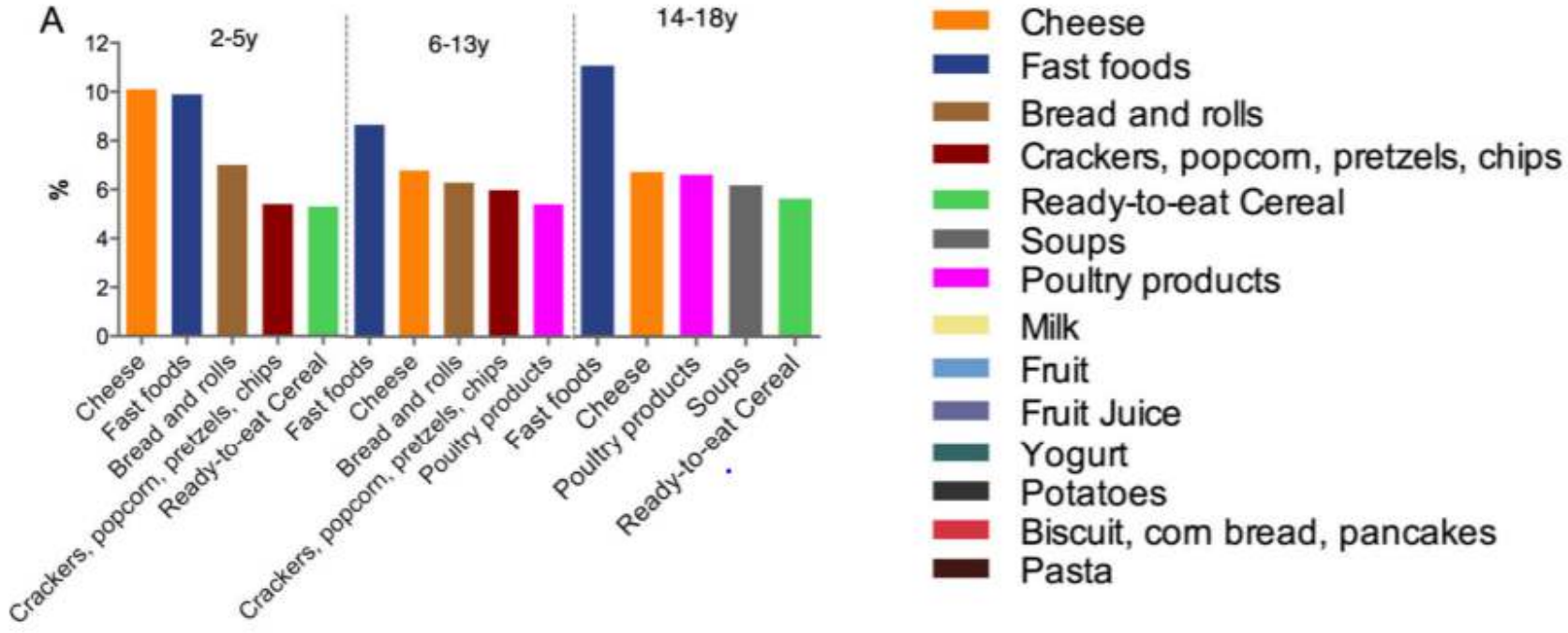
	Recommendations		General	CKD
	IOM & Health Canada		NHANES	CKid
Age (years)	AI (mg/d)	UL (mg/d)	mg/d	mg/d
1–3	1000	1500	2154	2180
4–8	1200	1900	2754	2873
9–13	1500	2200	3126	2937
14–18	1500	2300	3538	3884

More than 25% of adolescents consumed > 5150 mg sodium daily

Quader, Z et al J Acad Nutr Diet (2017)

Hiu, Pediatr Nephrol (2017)

Sodium Intake CKD



Chen et al, Pediatr Nephrol, (2017)

Sodium from other sources

Sodium Content of Medications

Sodium Polystyrene
1 g of powder = 100 mg of Na (4.1 mmol)

Sodium Bicarbonate
(Arm & Hammer Baking Soda)
1 g of powder = 275 mg of Na (12 mmol)

Sodium Content of Common Formulas per 100 kcal

			mmol	mg
My Liquids		**Kcal**	**Na**	**Na**
Breast milk *BCCH		100	1.6	37
NovaSource® Renal		100	2.1	48
Suplena® CARBSTEADY®		100	1.9	44
My Powders		**Kcal**	**Na**	**Na**
Nephea Kid (4.5 g/scoop)		100	1.8	41
Renastart™ (7 g/scoop)		100	1.9	44
Other Liquids	**Conc**	**Kcal**	**Na**	**Na**
Milk - Whole*		100	3.0	69

Challenges with Low Sodium Diet

1. Lack of control of sodium content of meals eaten away from home
2. Complex and time consuming nature of interpreting nutrition labels
3. Difficulty identifying suitable snacks

Nutrition Facts
Valeur nutritive

Per 1 oz (29 g)
pour 4 (29 g)

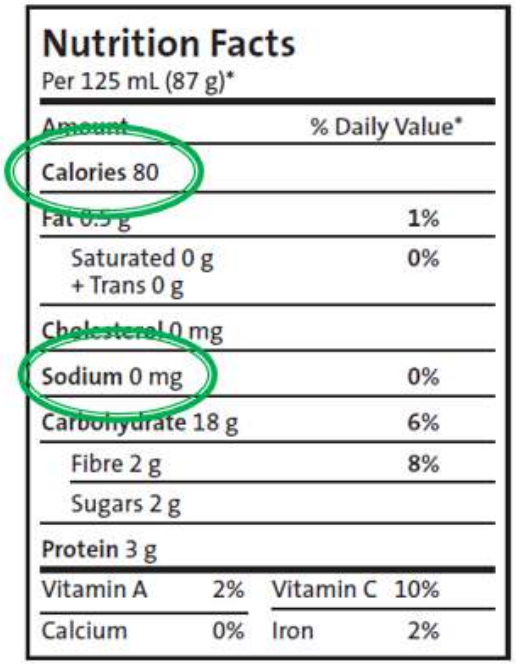
Amount / Teneur	% DV* / % VQ*
Calories / Calories 100	
Fat / Lipides 10 g	**15** %
Saturated / saturés 6 g + Trans / trans 1 g	**33** %
Cholesterol / Cholestérol 30 mg	
Sodium / Sodium 105 mg	**4** %
Carbohydrate / Glucides 1 g	**0** %
Fibre / Fibres 0 g	**0** %
Sugars / Sucres 1 g	
Protein / Protéines 2 g	
Vitamin A / Vitamine A	10 %
Vitamin C / Vitamine C	0 %
Calcium / Calcium	2 %
Iron / Fer	0 %

* DV = Daily Value
* VQ = valeur quotidienne

Lofthouse, Appetite, 2016

Sodium Prescription at BCCH

- Originally developed for NS population, now used department wide
- Goal is to choose food items that have equal to or less sodium mg than calories

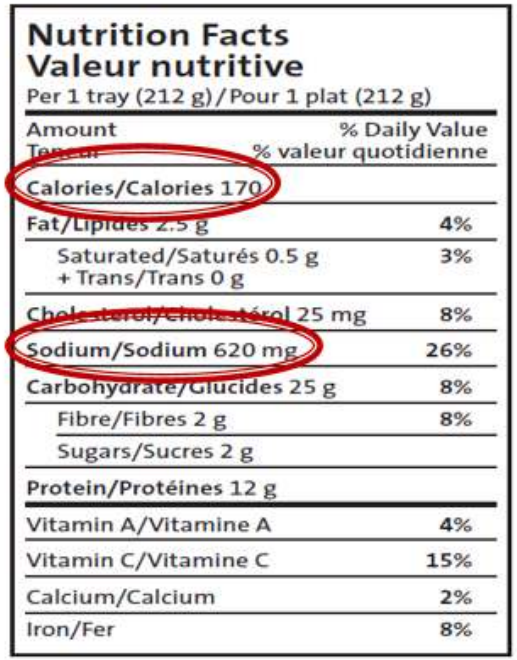


Nutrition Facts

Per 125 mL (87 g)*

Amount	% Daily Value*
Calories 80	
Fat 0.5 g	1%
Saturated 0 g + Trans 0 g	0%
Cholesterol 0 mg	
Sodium 0 mg	0%
Carbohydrate 18 g	6%
Fibre 2 g	8%
Sugars 2 g	
Protein 3 g	

Vitamin A	2%	Vitamin C	10%
Calcium	0%	Iron	2%



Nutrition Facts
Valeur nutritive

Per 1 tray (212 g) / Pour 1 plat (212 g)

Amount / Teneur	% Daily Value / % valeur quotidienne
Calories/Calories 170	
Fat/Lipides 2.5 g	4%
Saturated/Saturés 0.5 g + Trans/Trans 0 g	3%
Cholesterol/Cholestérol 25 mg	8%
Sodium/Sodium 620 mg	26%
Carbohydrate/Glucides 25 g	8%
Fibre/Fibres 2 g	8%
Sugars/Sucres 2 g	
Protein/Protéines 12 g	
Vitamin A/Vitamine A	4%
Vitamin C/Vitamine C	15%
Calcium/Calcium	2%
Iron/Fer	8%

Fluid Prescription

1. Fluid allowance needs to be <u>clearly documented</u> and regularly discussed
2. Close watch on changes in urine output
3. If oliguric or anephric, may need NG/G-tube and 2 kcal/ml formula
4. Fluid allowance is very individualized
5. Caregiver & family need to understand why need fluid restriction

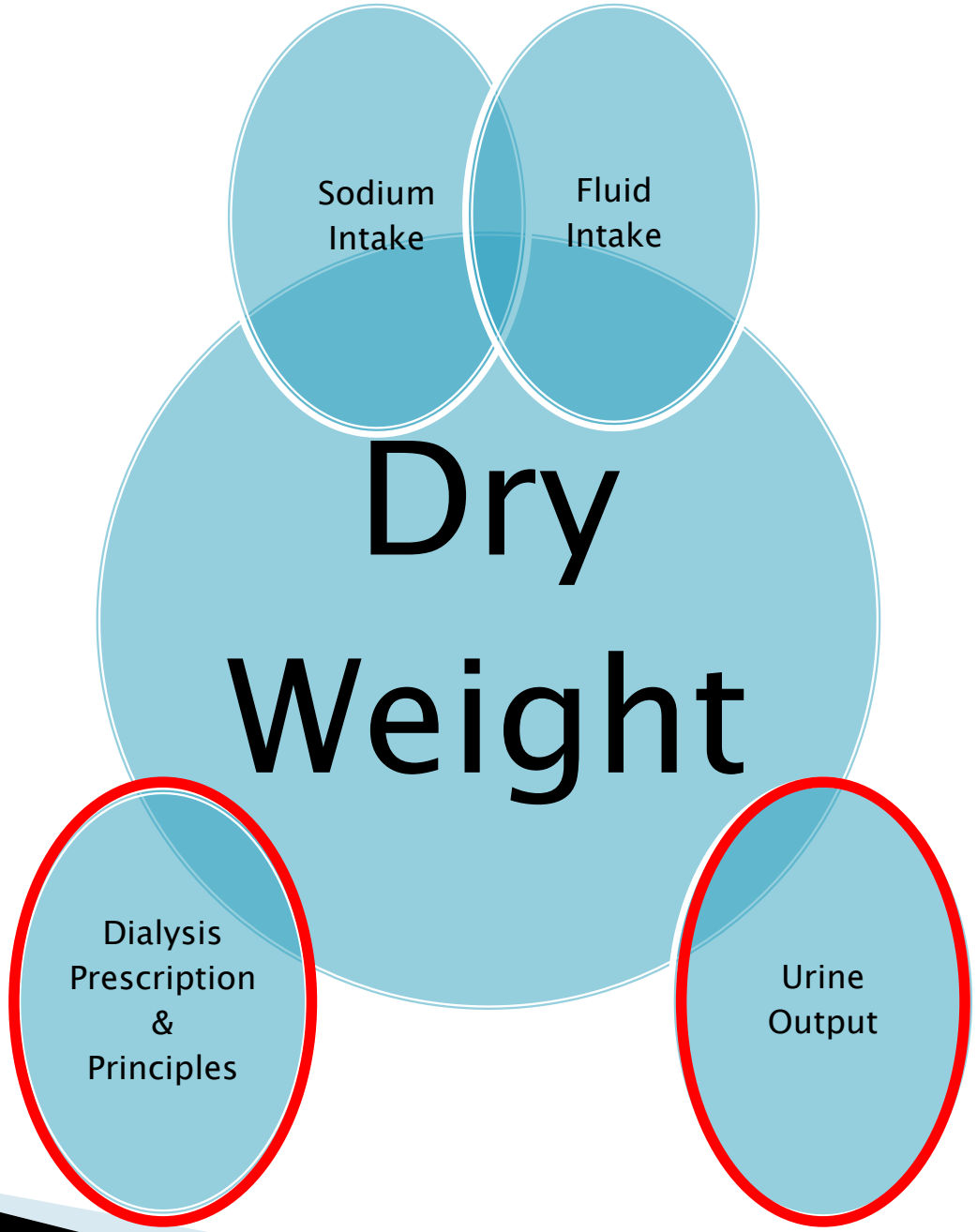
Educating Families

1. Does gaining a lot of fluid between treatments really matter? Does it hurt me?
2. Where does the fluid go?
3. How does dialysis get rid of the fluid?
4. Why do the doctors and allied health professionals tell me to limit my fluid?
5. Why can't you remove however much fluid I gain?

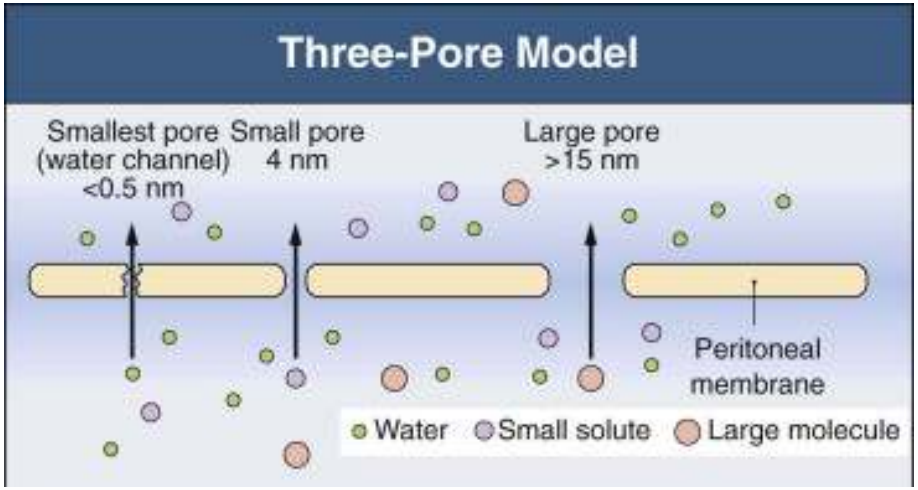
Brown, M., Burrows, L., Pruett, T., & Burrows, T. (2015). Hemodialysis-induced myocardial stunning: A review. *Nephrology Nursing Journal, 42*(1), 59-66

Assessing Fluid Intake

1. **Difficulty estimating portion sizes and keeping track of intake**
    - Multiple caregivers
    - School age children take responsibility
    - Drink out of fountains, taps, various cups
    - Recall information: 24 hour recall vs FFQ vs 3 day record
2. **What to count as fluid**
    - Total fluids, free fluids, fluid on trays, fluid from foods
    - IOM assumes food moisture contributes 20% total water intake; estimated to be 40% in China (Ozen et al, J Hum Nutr Diet)
3. **Sodium Intake**
    - Children with CKD consuming 2 x recommended intake sodium


Sodium Intake
Fluid Intake
Dry Weight
Dialysis Prescription & Principles
Urine Output

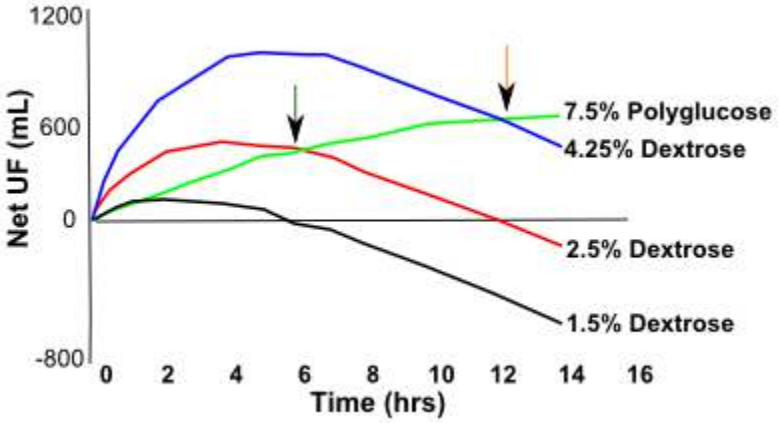
PD and Na^+/Fluid Removal



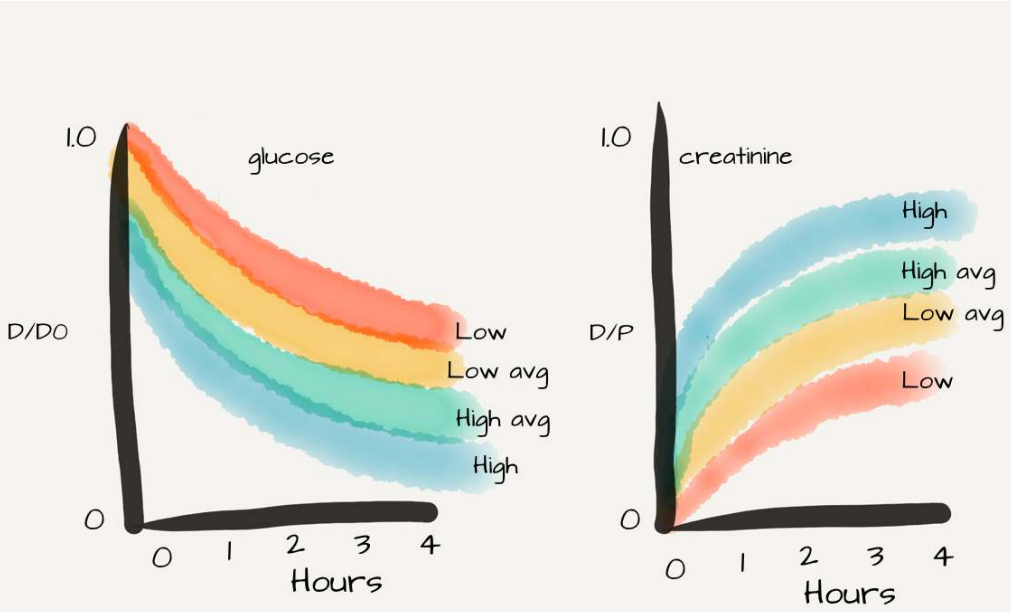
Water and sodium transport across the peritoneal membrane

Ultrafiltration (AQP-1 and small pores)	Sodium transport (Small pores)
1. AQP-1 (40% to 50%), solute-free water transport, by osmotic gradient 2. Small pores (50% to 60%), solute-coupled water transport, by osmotic and hydrostatic pressure gradient	1. Convective mass transport (coupled water) 2. Diffusive mass transport (determined by diffusion gradient, volume, and time) 3. Peritoneal absorption (fluid and solutes absorbed to interstitial tissue and lymphatics)

PD and Ultrafiltration



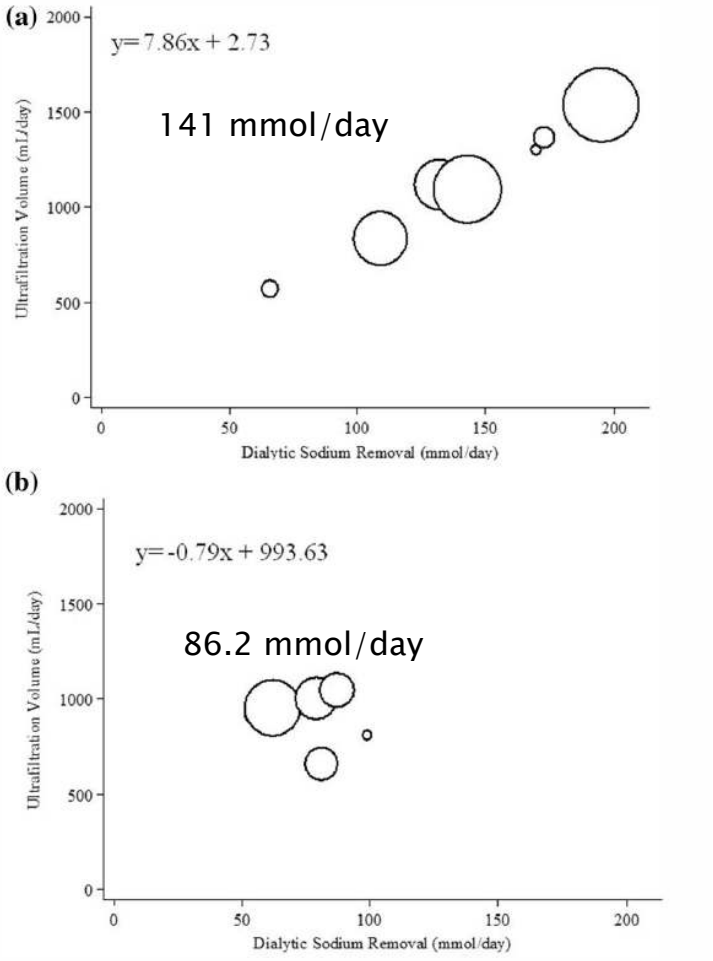
↑ dextrose concentration improves ultrafiltration



Peritoneal Equilibration Test (PET) determines membrane status.

High/high avg transporters have hardest time with optimal ultrafiltration

Na^+ Removal in PD: CAPD > APD



Continuous Ambulatory PD (CAPD)

Automated PD (APD)

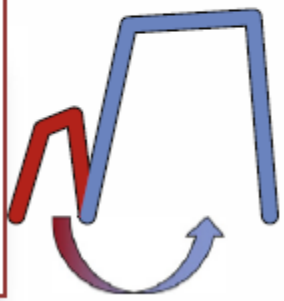
Borrelli S, Journal of Nephrology, 2018

Adapted Peritoneal Dialysis

The concept of adapted APD small/short exchange followed by large/long exchange to optimize dialytic sodium removal

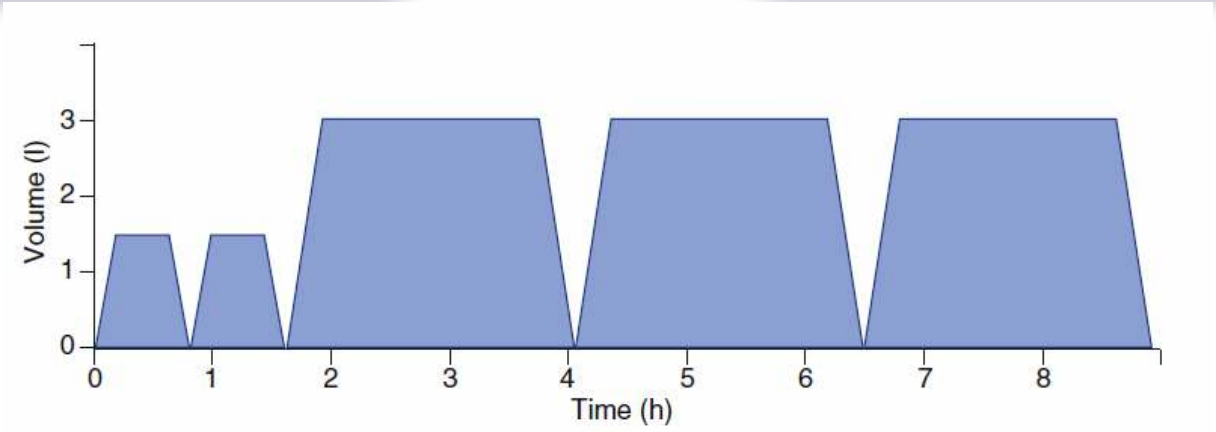
Exchange favoring UF

Short/small cycle
(Free water transfer via AQP-1)
- Hemoconcentration
- Incomplete drainage (low IPP)
- Low NaD



Exchange favoring dialytic Na removal

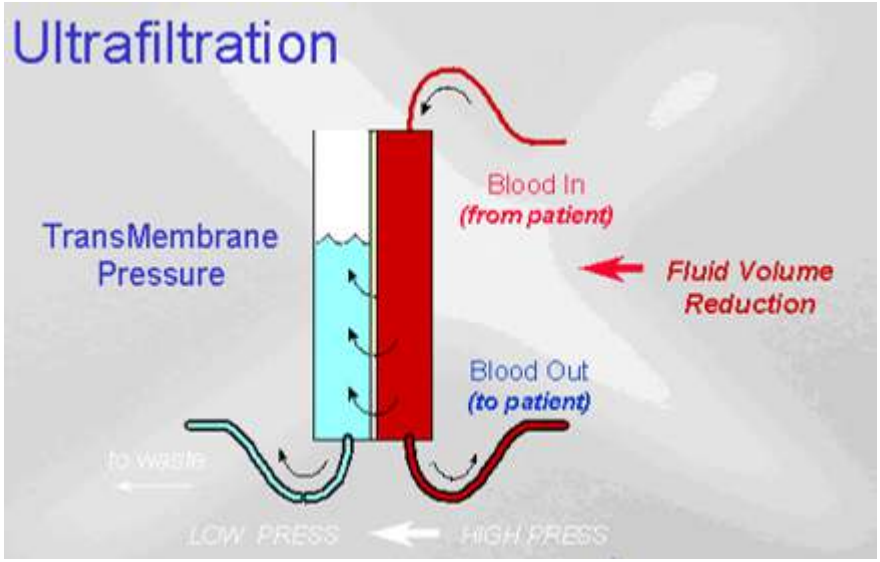
Long/large cycle
(Small pore recruitment)
- Na-coupled water transport
- Long diffusion time
- High diffusion gradient (NaPl/NaD)



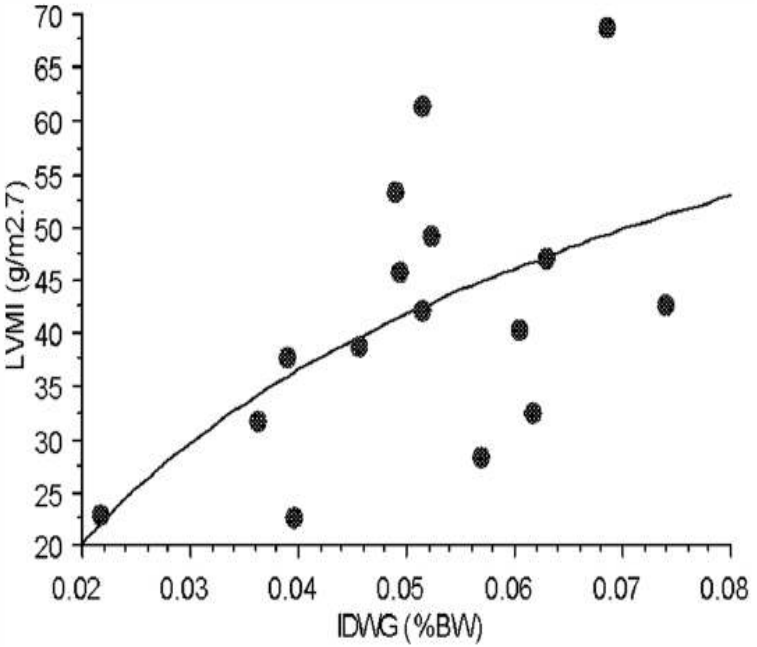
Fischbach M Kidney Int 2016

HD and Ultrafiltration

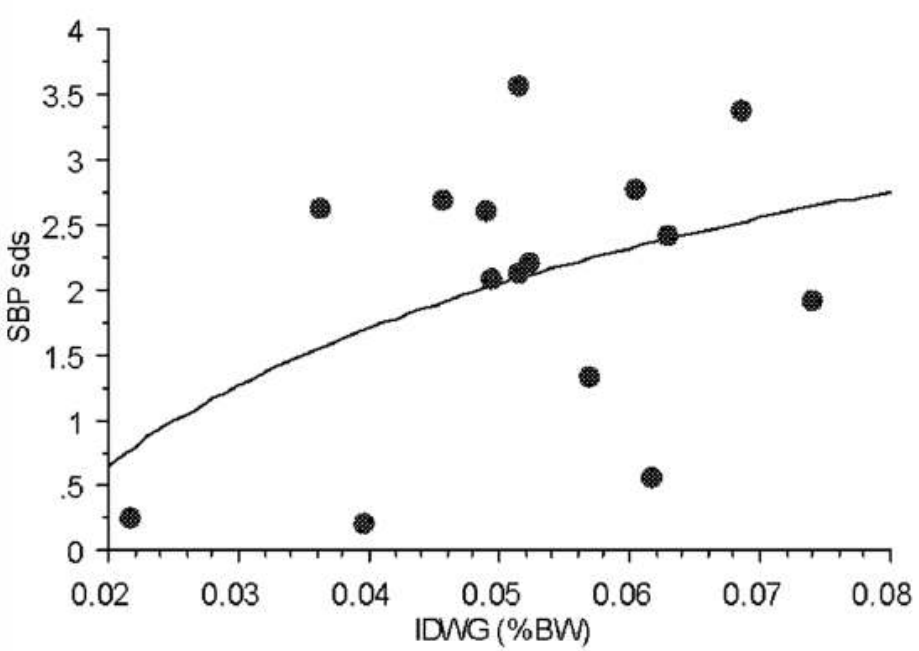
- Ultrafiltration (UF) set by the operator
- UF driven by a pressure gradient between blood and dialysate compartments
- Issue is that this is only done being 3-4x/week



Interdialytic Weight Gain (IDWG)



Left ventricular mass index



Systolic BP SDS

IDWG >4% associated with left ventricular hypertrophy (LVH)

Pagliolonga F Pediatr Nephrol 2015
Karava V Pediatr Nephrol 2018

HD strategies for safe UF

- Try & limit UF to 5% of weight/session
  - Adults:<13 ml/kg/hr (cardiac stunning risk)
  - If >5% IDWG, extend HD or run on extra day
- If patient not tolerating fluid removal, can try
  - Ultrafiltration profiling
    - Eg: 50% of UF in the 1st hour, and the remaining in the next 2-3 hours
  - Sodium profiling
    - Eg: Increasing dialysate Na [ ] above pt Na temporarily
- Decreasing dialysate temperature slightly
- Blood volume monitoring

Hothi DK et al CJASN 2009

HD Na^+ Removal Strategies

- For intermittent HD, Na^+ removal dependent more on *convective (80%) vs diffusive (20%)*
- Strategies around altering dialysate [Na^+] to optimize diffusive component:
  - Lowering dialysate [Na^+] to 134-138 mmol/L to optimize diffusive loss
  - Lowering dialysate [Na^+] to 2 mmol/L lower than serum
- 1 pediatric study (450 HD sessions in 5 pts)
  - ↓ dialysate Na from 140→138 lowered inter-dialytic weight gain and systolic/diastolic BP.

Marcenic O Hemodial Int 2016

Residual Urine Output

- Many of our patients have urine output and residual function at dialysis start, but does decline over time
  - Measure 24 hour urine volume at baseline and “frequently” during dialysis course
- Avoid nephrotoxins
- Consideration of diuretics (Furosemide) & ACE-I
- Avoid excessive UF and intradialytic hypotension
  - Risk in HD >> PD, but high UF volumes in PD has been associated with loss of residual UO
- Use of more biocompatible PD solutions

Ha IS et al, Kindey Int, 2015
Feber J et al Pediatr Nephrol 1994
Fischbach M et al Adv Perit Dial 2001

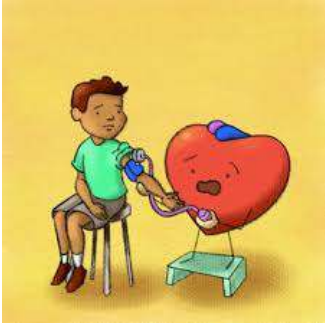
Dry Weight Assessment Tools

1. Physical Exam (Edema & BP)
2. Serial Weight Analysis
3. Lab Results (Sodium, Hemoglobin, Albumin)
4. Bioimpedance Analysis (PD & HD)
   - BCM: OH (L), OH/ECW (%)
5. Blood Volume Monitoring (HD)

Physical Exam (Edema)

- Hard to detect in chronic dialysis patients
  - Most of our patients have “hidden” fluid overload
- Have to have at least 10% of excess fluid on board to manifest edema
- Hard to quantify & subjective assessment

Blood Pressure

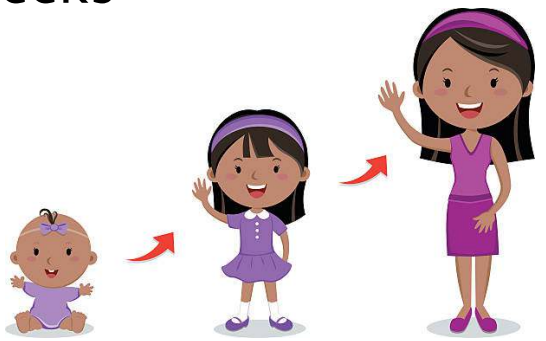


- PD: Measured daily in AM at home
- HD: Measured pre, post, and several times during HD
- ***Elevated BP <u>often</u> denotes ECV expansion***
- If elevated:
  - Look at recent trends for consistency/timing
  - Ensure correct cuff size
  - Could stress/anxiety/discomfort be an issue?
  - How many BP agents is patient on?
- If concerned about "white coat" HTN, can do a 24 hour ambulatory BP monitor

Weight Analysis

1. Plot weight(s) on growth chart; electronic
2. WHO before 2 yrs of age; CDC after 2 yrs
3. Look at trends; changes in z-score
   - Q. Represent nutritional weight gain?
   - Q. Represent overhydration/underhydration?
   - Q. Any infections, diarrhea, vomiting, changes appetite
   - Q. Decrease in urine output (AKI, progression)
4. Example: Gain of 200 grams

6 week old	~ 1 week
7 year old	~ 1 month
14 year old	~ 2- 3 weeks



Lab Results (Clues of Overhydration)

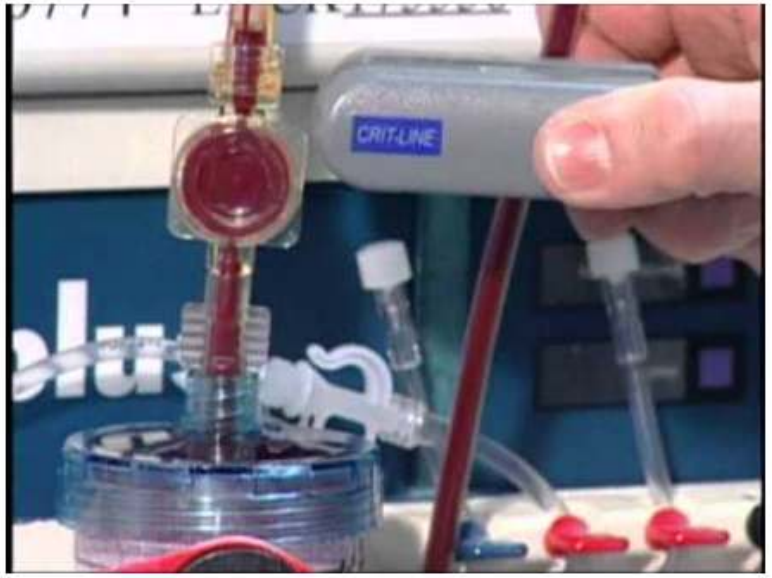
- Low serum sodium
  - Hyponatremia most often signifies free water ↑
  - Does not mean the patient needs ↑ Na^+
- Low hemoglobin
  - Often low in dialysis patients
  - Unexplained ↓ in Hb may signify hemodilution
  - Analyze recent ↑ ESA dose requirements
- Low albumin
  - Can be ↓ in malnutrition, and inflammatory states
  - In a stable patient, ↓ in albumin may also signify hemodilution

Borzych-Duzalka D J Am Soc Nephrol 2013
Jones CH J Ren Nutr 2002

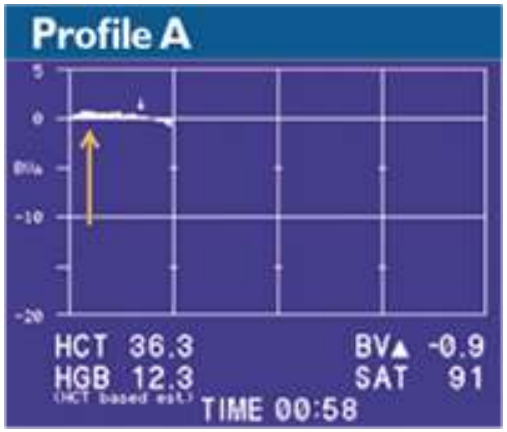
Blood volume monitoring in HD

- Non-invasive technology that measures blood volume (BV) change in real time
- Measures relative change in hematocrit in response to ultrafiltration (UF)
- Relative BV ↓ with UF (↑ in HCT)
- Slope of the BV curve determined by
  - 1) rate of fluid removal (UFR)
  - 2) ability to refill the vascular space from the interstitial space

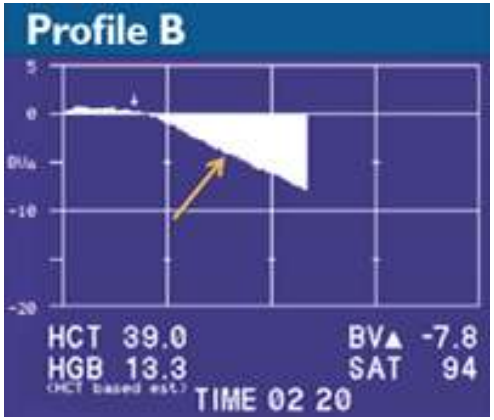
CritLine Monitor



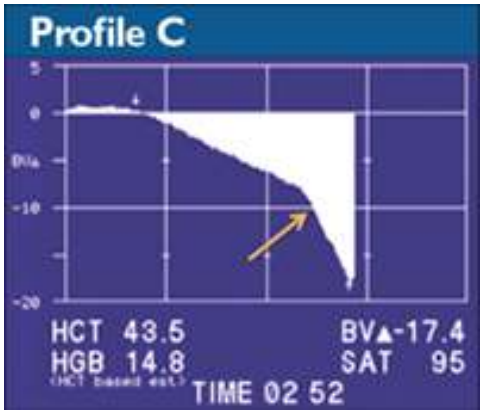
Example of BVM profile during HD



No change in BV



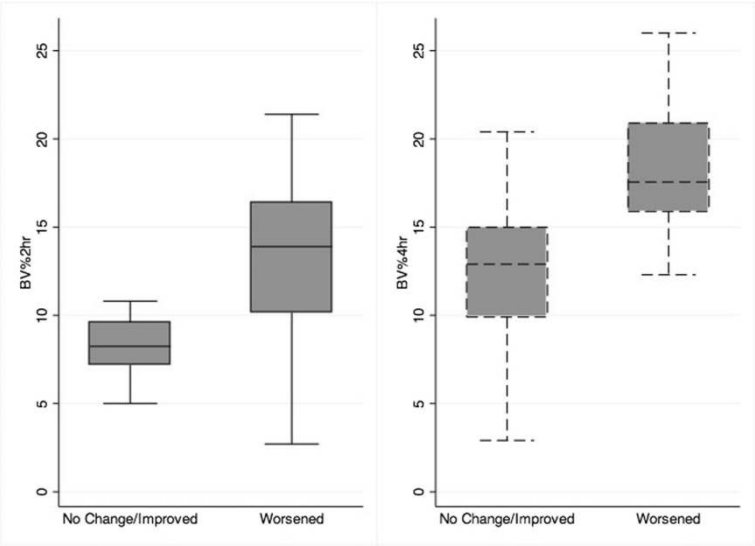
Gradual ↓ in BV



Steep ↓ in BV

Safe BVM changes in children

- *Safe UF rate defined by BV change of <8% per hour in 1st 90 min and <4% after with no more than a 12% net RBV change per dialysis session (based on intradialytic events)*



Cardiac Index changes at
2 hrs and 4 hrs into HD

Jain SR Pediatr Nephrol 2001
Geer J Pediatr Nephrol 2017
Michael M Pediatr Nephrol 2004

Finding Dry Weight with Crit Line Monitoring (HD)

Nurse places patient into a minimum UF profile (0.1L/hr) with 15 min remaining on the HD run

Then look at the BV change after. If BV ↑ (ie refilling occurs), then there is more fluid to remove

Case 1: NR

- Diagnosed with NS at 2 yrs of age (FSGS)
- HD started at 5 yrs of age along with G tube insertion
- Transitioned to PD at 6 yrs of age

Trends Clinic Visits

	Oct 1	Oct 29	Dec 3
Blood Pressure	110/78	↑ 119/78	↑ 124/88
BP Medications	None	None	Amlodipine 5 mg
Albumin	39 g/L (3.9 g/dL)	38 g/L (3.8 g/dL)	41 g/L (4.1 g/dL)
Hemoglobin	101 g/L (10.1 g/dL)	109 g/L (10.9 g/dL)	119 g/L (11.9 g/dL)
Sodium	140 mmol/L	134 mmol/L	137 mmol/L
Weight	18.7 kg	19.4 kg	20.8 kg
BCM (absolute) OH/ECW %	-0.7 L -16.6%	-0.6 L -14.5%	-0.7 L -16.5%

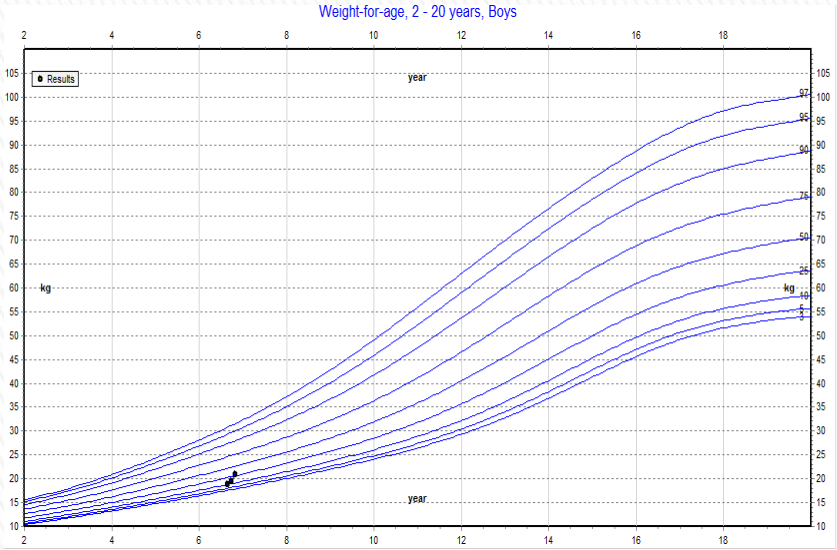
Admitted to hospital for 4 weeks in September with peritonitis and pneumonia
Received suboptimal dialysis and nutrition

Clinic Visit

N.R (7 yrs old)	December 3
Dialysis PD: High Transporter	10 cycles, 12 hrs UF 300 ml mix of 1.5 and 2.5% UF 600 ml 2.5% 2.5% Dianeal used 3 last 4 weeks 800 ml fill; last fill Extraneal
Fluid/Diet	Total: ~800 ml *+thirsty 700 ml formula feed + 100 ml additional fluids 60 ml HBTF; Oral intake unchanged, minimal
Output	Unchanged; 15 ml urine
Growth (SD) Goal Wt	20.8 kg (- 0.59) Goal Wt 18.3-18.6 kg

Other Parameters

Weight



01-Oct-2018	6 years	18.74 kg	9.94	-1.28
29-Oct-2018	6 years	19.40 kg	14.29	-1.07
03-Dec-2018	6 years	20.80 kg	27.90	-0.59

Feeds

	Vol	Kcal	Pro (g)	Fat (g)	CHO (g)	Na (mmol)	K (mmol)	Ca (mg)	P04 (mg)	Iron (mg)
My Powders	**Scoops**	**Kcal**	**Pro**	**Fat**	**CHO**	**Na**	**K**	**Ca**	**P04**	**Iron**
Nephea Kid (4.5 g/scoop)	56.0	1230	16	60	151	21.9	1.3	378	66	9
Other Liquids	**ml**	**Kcal**	**Pro**	**Fat**	**CHO**	**Na**	**K**	**Ca**	**P04**	**Iron**
Milk - Whole*	300	189	10	10	15	5.7	10.5	350	261	0
TOTAL VOLUME (mL)	700									
Concentration (Kcal/mL)	2.0									
TOTAL Nutrients		1419	26	71	166	28	12	728	327	9
% kcals/nutrients *			*7%*	*45%*	*47%*			*73%*	*65%*	
Nutrient/kg		71	1.3	4	8	1.4	0.6	36	16	0
								Ca/P04 Ratio Formula		
								2.2		
Suggested Dietary Intake (SDI)								700-1000	440-800	
Recommended Intake: KDOQI			1.35					≤2000	≤400	
Recommended Intake: DRI/AI	**4-8 years**	1381	0.95			52	97	1000	500	10
Upper Limit								2000		

Calories from dialysis
~200 kcals

Physical Exam

September

December

Assessment

Overhydrated

- Mild hypertension
- ? Faster then expected rate of wt gain
- Thirst ? going over fluid restriction

Not Overhydrated

- No overt edema
- ? Wt gain explained by 2.5% dialysate; excessive calories; catch up growth after admission
- ? Thirst caused by 2.5% dialysate
- Albumin WNL
- Reported fluid intake WNL
- BCM trends; showing underhydrated
- Minimal sodium intake
- Optimal dialysis

Not Overhydrated

1. Decreased calories by 15%
2. Increased dry weight 20.6-21 kg
3. Changed dialysis combination 1.5 and 2.5% (from all 2.5%)
4. Increased Amlodipine

Trends Clinic Visits

	Dec 3	Jan 14	Feb 11
Blood Pressure	↑ 124/88	↑128/86	↑ 132/88
Meds	Amlodipine 5mg	Amlodipine 7.5mg	Amlodipine 10mg Enalapril 7.5 mg
Albumin	41 g/L (4.1 g/dL)	38 g/L (3.8 g/dL)	36 g/L (3.6 g/dL)
Hemoglobin	119 g/L (11.9 g/dL)	122 g/L (12.2 g/dL)	105 g/L (10.5 g/dL)
Sodium	137 mmol/L	137 mmol/L	137 mmol/L
Weight (SD)	20.8 kg (-0.59)	22.5 kg (-0.14)	21.9 kg (-0.40)
BCM absolute OH/ECW %	-0.7 L -16.5%	-0.3 L -5.9%	-0.4 L -8.8%
Other			LVH

Physical Exam

December

February

Assessment

Overhydrated

- More Hypertensive
  - LVH
  - Now on 2 agents
- Edematous
- Relative ↑ in BCM
- Serum albumin ↓
- High transporter

The Plan

- ↑ Enalapril
- ↓ daily TFI to 500 ml
- ↓ dry weight – find lowest wt tolerated

December Wt: 20.8 kg

February Wt: 21.9 kg

March Wt: 19.1kg

One week later…
BP 108/76, down to 1 BP med
BCM -0.9 L (-24.1%)

Take Home Points

1. BCM and labs can be misleading
   - Always had a negative BCM (underhydration)
2. When you think you have reached dry weight, record weight as new set point
3. Pay close attention to blood pressure trends and hypertension
4. Serial pictures can be helpful in assessing for edema
5. “Sometimes you just need to dry them out”

Case 2: TP

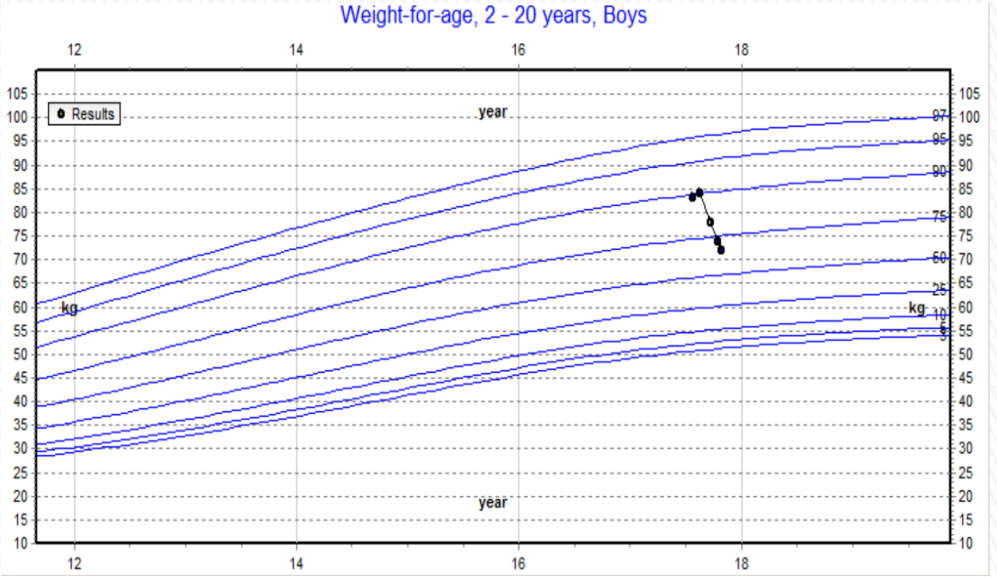
https://m.facebook.com/rmhbc/posts/10158066058178478

- Presented with oliguric AKI at 17 years of age with SCr 3560 umol/L (40.3 mg/dL), urea 82 mmol/L (230 mg/dL)
- Diagnosis: ANCA Vasculitis
- Renal biopsy: 80% of glomeruli global sclerosis
- CRRT x 4 days, transitioned to intermittent HD

Decision made to start PD as family lives 7 hours from BCCH

PD Journey

- PD for 4 months with little residual UO
- Low transporter (PET)
  - No UF concerns
  - BCM close to 0
- Inadequate PD clearance (weekly Kt/V 0.8)
- Extreme weight loss and nausea, severe anemia decision to transition to in center HD



Lost 10 kg since transition to PD; 12% body weight

Back on HD

	August
Dialysis HD	4 times per week, 3.5 hours M, W, F & 3 hours Sat
Fluid/Diet	1 tetrapack Novasource Renal Fluid Prescription: 1 L
Urine Output	none
Blood Pressure	116/57
HTN Meds	None
Albumin	32 g/L (3.2 g/dL)
Hemoglobin	92 g/L (9.2 g/dL)
Sodium	138 mmol/L
Growth (SD) Goal wt	73.9 kg (+0.5) 74 kg
BCM absolute OH/ECW %	+2.8L 17.8%
BCM Goal Wt	71.1 kg

https://www.clearwatertimes.com/news/b-c-girl-makes-birthday-wish-for-ronald-mcdonald-house-after-uncles-kidney-transplant/

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July
Blood Pressure	141/69	147/82	134/67	146/79	116/65	138/77	144/69	135/75	128/69	118/65
Meds (mg)	Amlodipine 5-10-15	Amlodipine 15	Amlodipine 15	Amlodipine 15 Enalapril 5	Amlodipine 15	Amlodipine 15	Amlodipine 15	Amlodipine 15 Enalapril 5	Amlodipine 15 Enalapril 5	Amlodipine 15 Enalapril 5
Echo		LVH					LVH			
Alb (g/L)	35	39	41	38	39	40	41	41	39	38
Hgb (g/L)	102	130	142	119	118	112	104	116	133	117
Na (mmol/L)	142	138	137	138	137	135	140	136	137	137
Pre HD Wt (kg)	70.7	68.6	66.7	66.8	66.4	66.8	66.8	64.6	65.6	64.7
Goal Wt (kg)	70.4	67.1	64.5	64.7	64.7	64.8	65	62.5	62.5	62.8
BCM (L) OH/ECW %	+4.4 26.6%	+1.3 9.4%	+1.8 13%	+2.2 16.5%	+0.2 1.3%	+3.1 20.2%	+3.4 22.7%	+1.7 12.1%	+3.0 19.9%	+2.6 18.7%
BCM Goal Wt (kg)	66.3	67.3	64.9	64.6	66.2	63.7	63.4	62.9	62.6	62.1
IDWG	1-2%	1-2%	4%	3%	2%	4%	1-2%	1-2%	5%	6%
Other	G-tube inserted					COVID 3x week HD			Cramping Max blood vol > - 12%	Cramping Max blood vol > -12%

Take Home Points

1. Declining nutrition status makes finding goal weight even harder
2. An example of fluid/Na^+ issues better controlled on PD vs HD
3. Example of classical 3x/week HD not adequate for fluid removal

https://www.clearwatertimes.com/news/b-c-girl-makes-birthday-wish-for-ronald-mcdonald-house-after-uncles-kidney-transplant/

Take Home Messages

- "Finding goal weight" is one of the most challenging issues for dialysis patients, families and the health care team
- Even under close "watch" changes in dry weight happen quickly
- A multi-disciplinary approach is essential in assisting with fluid assessment and management in the pediatric dialysis population

Questions