Nutritional Challenges and Enteral Supplementation Strategies Across the CKD Spectrum

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Learning Objectives

- A case-based interactive review of nutritional challenges across the spectrum of CKD, HD, PD, and after transplantation.
- Nutritional interventions and solutions.
- To have a basic understanding of nutritional management across the entire CKD spectrum.

2018 ASPN MULTIDISCIPLINARY SYMPOSIUM

Goals of Nutrition Therapy

- Maintain adequate intake of macro and micronutrients
- Avoid uremic toxicity, metabolic imbalances, and renal bone disease
- Optimize growth and development
- Reduce risk of chronic morbidities and mortality in adulthood

CKD: Impact on All Organs

Bones can break, muscles can atrophy, glands can loaf, even the brain can go to sleep, and not endanger our survival, but should the kidneys fail in their task neither bone, muscle, gland nor brain could carry on.

From Dr. Homer W. Smith: Fish to Philosopher

Unique Aspects & Impact on Nutrition

CAKUT	GLOMERULAR
• Polyuria, excessive thirst	• Fluid and salt overload
• Salt wasting	• Hypertension
• Decreased protein synthesis due to salt-wasting*	• Protein loss
	• Dyslipidemia

- Metabolic acidosis: Decreased IGF-1 and GH receptors. Increased steroid production & protein degradation
- GH resistance

*Parekh et al. JASN 2001:12:2418-2426 **Rodig et al. Pediatr Nephrol (2014) 29:1987–1995

Altered Body Composition

- Lean mass deficit and increase in fat mass
- Impaired growth, short stature with altered trunk: limb ratio
- Increased Waist to Height Ratio
- Growth hormone resistance and decreased exercise capacity may be responsible for increased WHr

Silverstein D. Growth and Nutrition in Pediatric CKD. Front. Pediatr., 14 August
Rashid et al. Pediatr Nephrol 21:1730-1738, 2006

Causes of Malnutrition in CKD/ESRD

Altered taste sensitivity

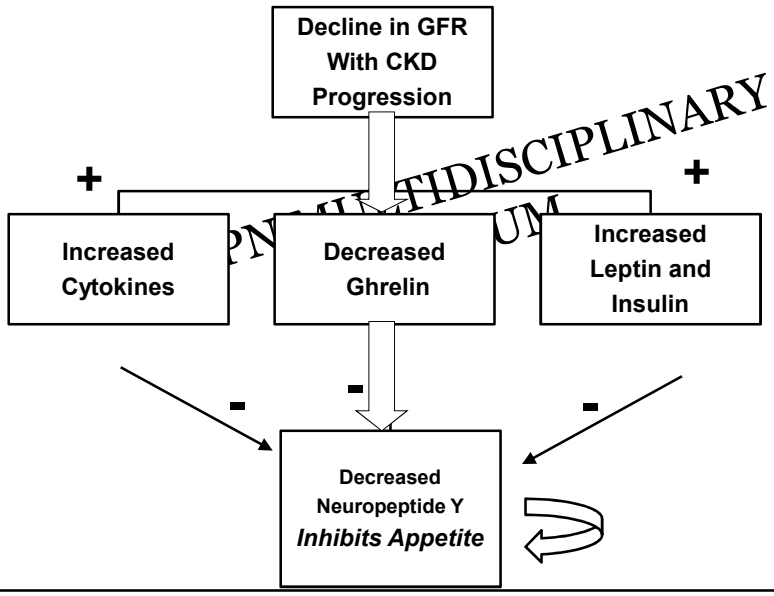
- Micronutrient deficiencies (Zinc)
- Decreased # of taste buds*

Anorexia and poor growth

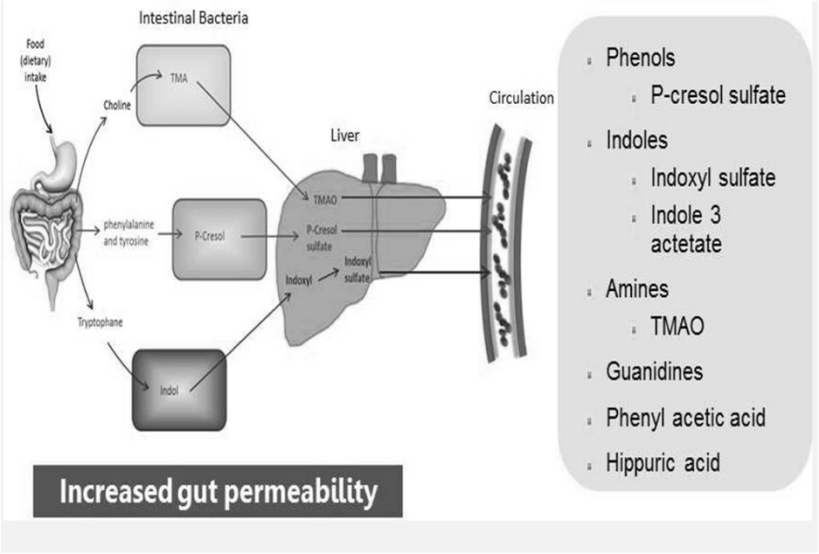
- Unpalatable prescribed diet and binder regimens
- Alterations in hormonal and neuropeptide signaling
- Altered microbiome with uremic toxins
- Renal osteodystrophy: adynamic bone disease or hyperparathyroidism; destruction of growth plate, epiphyseal displacement, metaphyseal fractures

*Correa et al. Reduced taste function and taste papillae density in children with chronic kidney disease. Pediatr Nephrol (2015) 30:2003–2010.

Neuropeptide Alterations and Appetite



Altered Microbiome in CKD



Nallu, et al. Gut microbiome in chronic kidney disease: challenges and opportunities. Transl Res. 2017 Jan;179:24-37.

Impact of Dialysis on Nutrition

Hemodialysis-specific

- Stricter fluid and electrolyte limits pose significant challenges in younger anuric children
- Carnitine deficiency
- Negative protein balance at the end of HD
- Chronic inflammation, oxidative stress

PD-specific

- Delayed gastric motility, GER, and vomiting
- Early satiety
- Increased protein losses and glucose absorption

Nelms C. Optimizing Enteral Nutrition for Growth in Pediatric CKD. Front. Pediatr., 02 August 2018

Defining Malnutrition

- Defined as Wt/Ht or BMI ≤ -1 SDS*
  - -1 to -1.9 **mild**
  - <-2 to -2.9 **moderate**
  - ≤-3 **severe**
- Height/age ≤ -3 SDS: consider non-nutritional factors
- Other parameters:
  - Nutritional intake
  - Rate of weight gain or loss
  - Growth velocity
  - Mid-upper arm circumference
  - *WHr***
  - *Trunk to limb ratio*

*Becker, P., *Consensus statement of the AND/ASPEN.* Nutr Clin Pract, 2015. **30**(1): p. 147-61.

**Sgambat, Moudgil et al. Waist-to-height ratio, body mass index, and cardiovascular risk profile in children with chronic kidney disease. Pediatr Nephrol. 2018 .

Malnutrition and PEW

Malnutrition: *"An imbalance between nutrient requirement and intake, resulting in cumulative deficits of energy, protein and micronutrients negatively affecting growth, development and other health outcomes"*

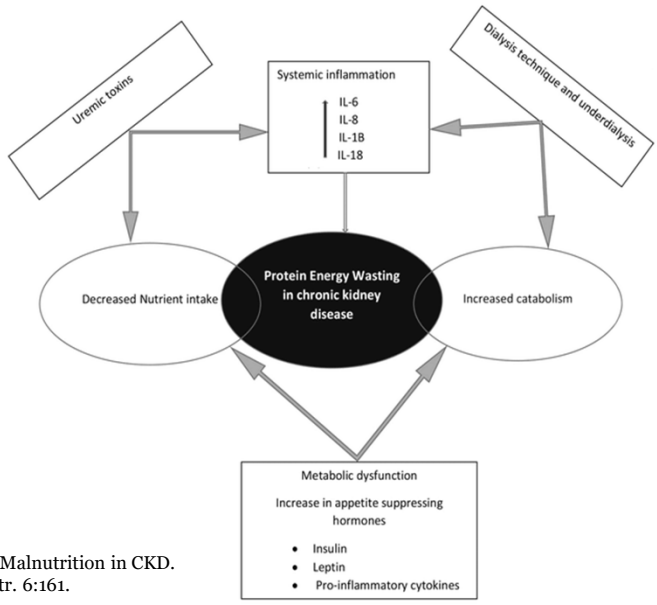
Mehta et al. Defining Pediatric Malnutrition. JPEN Volume 37, Issue 4, July 2013, p 460-481

Protein Energy Malnutrition: *A state of decreased body stores of protein and energy fuels*

Protein Energy Wasting: *Refers to multiple nutritional and catabolic alterations occurring in CKD which can't be corrected by increasing energy intake*

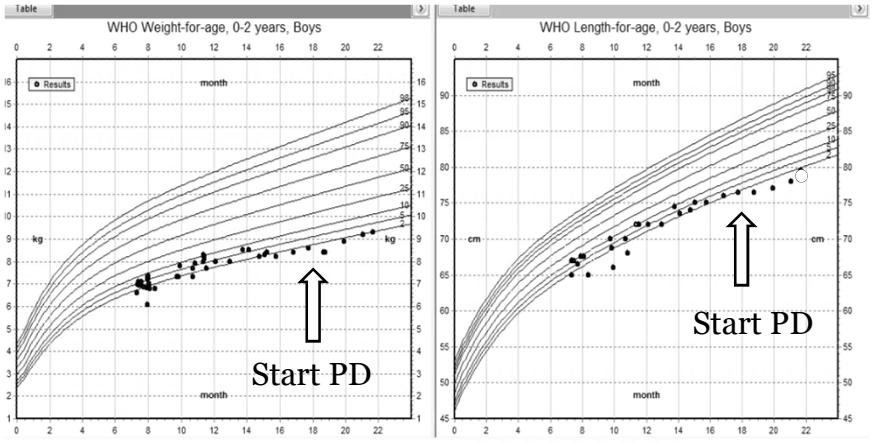
Fouque D et al. A proposed nomenclature and diagnostic criteria for protein-energy wasting in acute and chronic kidney disease. Kidney Int. (2008) 73:391–8.

Protein Energy Wasting in Dialysis



Iorember F. Malnutrition in CKD. Front. Pediatr. 6:161.

Case 1: CKD to PD



- Male with CKD at 8 months sec. to PUV
- Started PD at 18 months, G-tube not placed
- Loss of appetite, decreased formula intake, stopped eating food
- Vomiting
- Decline in weight gain and growth velocity

What will you do first?

A. 

B. Higher calorie containing oral formula
C. Appetite stimulants
D. Growth Hormone
E. Pro-motility agent
F. NG tube feeding
G. G-tube feeding
H. GJ-tube feeding
I. Change to HD

Nutritional Options: Oral

- High caloric strength formulas and protein bars/powders
- High calorie and protein diet

Advantages:

- No need for surgery

Disadvantages:

- Expensive and inability to afford
- Unacceptable taste
- Non-adherence
- In children on PD <2 years, BMI decreased with oral feeding and increased with NG/GT feeding*

*Rees et al: JASN 2011: 22: 2303-2312

Formula Options

Formula	Age Group	Caloric Concentration	Features
Similac PM 60/40 Or breastmilk	Infant	20 kcal/oz	Low lytes
Renastart	Pediatric	30 kcal/oz	Very low protein, very low lytes
Novasource Renal (or Nepro)	Adolescent/Adult	60 kcal/oz (54 kcal/oz)	High Protein, low Lytes
Suplena	Adolescent/Adult	54 kcal/oz	Moderate Protein, low Lytes
Renalcal	Adolescent/Adult	60 kcal/oz Enteral only	Low protein, Electrolyte Free
Ensure Clear	Pediatric/Adult	30 kcal/oz	Clear Liquid, no K or Phos
Blenderized diet	Custom designed recipe to meet nutrient needs via Gtube Limitations- bolus only, food safety, labor intensive		

Pharmacologic Therapies

CURRENT

- Pro-motility agents
- Appetite stimulants
  - Megestrol acetate
  - Cyproheptadine

FUTURE

- Ghrelin: Appetite stimulating hormone
  - S/C injections studied in PD patients, found to stimulate food intake over 3* and 7** days
  - No adverse effects

*Wynne K. et al. J Am Soc Nephrol. 2005;16:2111-2118
**Ashby et al. Kidney Int. 2009; 76:199-206

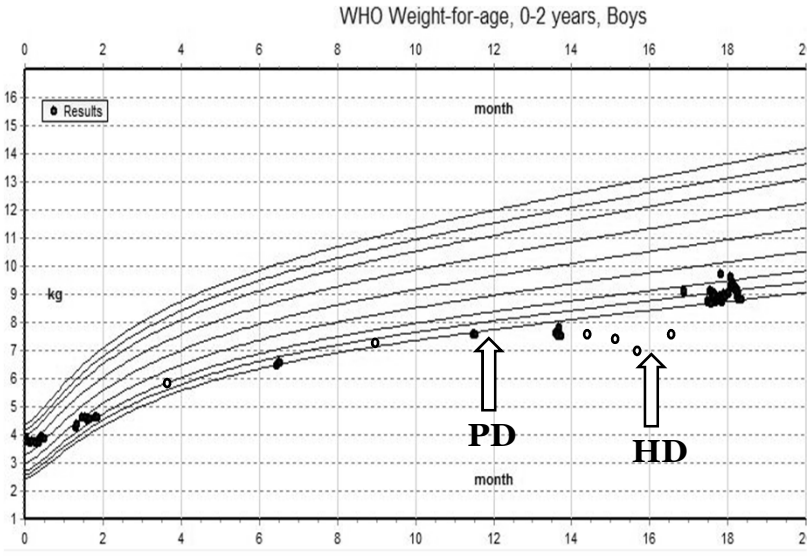
Enteral Nutrition Support

- Early intervention with enteral supplementation is the key*

Route	Advantages	Disadvantages
NG	• No surgical intervention • Easily removed	• Likely to be pulled out • Gagging, emesis, GER • Post-traumatic feeding disorder
G-tube	• Best choice for long-term • Flexibility to give bolus and/or overnight feeds	• Surgical placement • Risk of infection • Placing G-tube prior to PD catheter reduces infection risk**
GJ tube	• Bypasses stomach, ensures nutrition in those with vomiting	• Slow continuous rate • Difficult to replace • May still have retching • Certain medications can not be given

*Mekahli et al. Long term outcome of infants with severe CKD. CJASN 2010. 5:10-17.
**Rees L and Brandt M. Tube feeding in children with chronic kidney disease: technical and practical issues. Ped Neph. (2010) 25:699-704.

Change of Dialysis Modality



Case 2- Anuric Child on HD

- 2 year old ESRD, sec to ARPKD, on chronic HD, MWF
- Anuric, s/p bilat. nephrectomies
- G-t dependent, refuses PO
- Fluid restriction 500 ml/day
- Caloric needs ~1120/day

What will you do?

A.

B. High caloric formula
(70 kcal/oz to meet needs within fluid limit)

C. Increase frequency of dialysis

D. Aggressive PO feeding therapy

E. Concentrated blenderized diet

F. Change to PD

What will you do?

A. Do nothing

B. High caloric formula (70 Kcal/Oz)

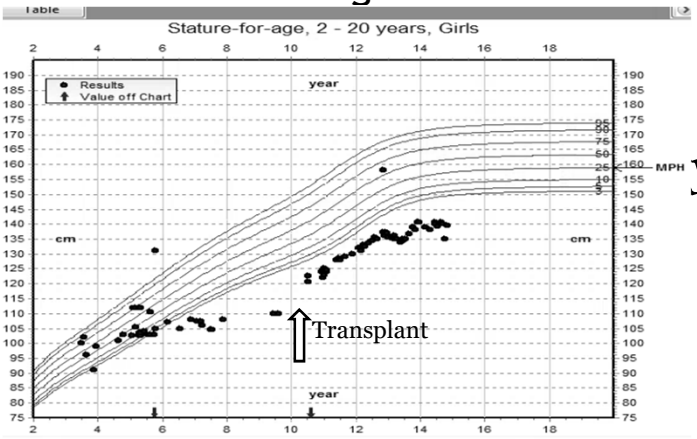
C. Increase frequency of dialysis

D. Aggressive po feeding therapy

E. Concentrated blenderized diet

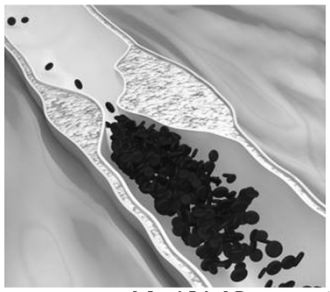
F. Change to PD

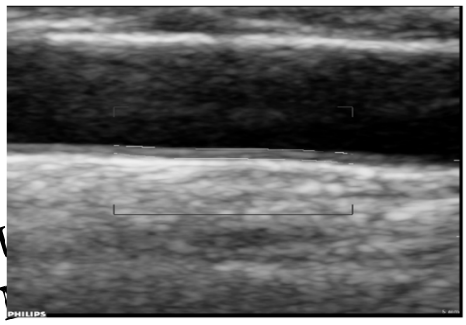
Case 3: BMD affecting Nutrition and Growth



- ESRD sec. to ANCA+ GN at age 3 years
- Chronic HD from age 3 to 10
- Severe osteodystrophy
- Very poor growth, calcifications on HD
- Labs: Ca 11.0, Phosphorus 10.0, iPTH 3,200
- Improved growth post-transplant

Calcifications in soft tissue and arteries





What will you do?

A. 

B. Growth hormone
C. Low phos diet
D. Increase calcium carbonate
E. Change calcium carbonate to sevelamer
F. Increase calcitriol dose
G. Add Cinacalcet
H. C, E and G

What will you do?

A. Do nothing

B. Growth hormone

C. Low phos diet

D. Increase calcium carbonate

E. Change calcium carbonate to sevelamer

F. Increase calcitriol dose

G. Add Cinacalcet

H. C, E and G

Solutions: Bone Management for Growth*

- Limit **phosphorus** intake to 80% of DRI when PTH and phosphorus levels elevated
- **Binders** (calcium vs. non-calcium)
  - Limit calcium intake to 2x DRI
- **25 hydroxy vitamin D**
  - <30 ng/mL- supplement to replete
  - Maintenance dose ≥30 ng/mL
- **Active vitamin D:** initiate when 25-hydroxy D>30 and PTH above target
- **Cinacalcet-** more evidence needed

Davita.com

*KDOQI Guidelines: Nutrition in Children with CKD: 2008

Bone management-Cinacalcet

Pediatric Nephrology
https://doi.org/10.1007/s00467-018-4054-8

ORIGINAL ARTICLE

An open-label, single-dose study to evaluate the safety, tolerability, pharmacokinetics, and pharmacodynamics of cinacalcet in pediatric subjects aged 28 days to < 6 years with chronic kidney disease receiving dialysis

Winnie Y. Sohn[1] · Anthony A. Portale[2] · Isidro B. Salusky[3] · Hao Zhang[1] · Lucy L. Yan[1] · Bella Ertik[1] · Shahnaz Shahinfar[4] · Edward Lee[1] · Bastian Dehmel[1] · Bradley A. Warady[5]

Received: 8 May 2018 / Revised: 7 August 2018 / Accepted: 10 August 2018

- 0.25 mg/kg shown to be safe starting dose in children on dialysis <6 years old

Pediatric Nephrology
https://doi.org/10.1007/s00467-018-4055-7

ORIGINAL ARTICLE

Cinacalcet as rescue therapy for refractory hyperparathyroidism in young children with advanced chronic kidney disease

Aura J. Arenas Morales[1] · Marissa J. DeFreitas[1] · Chryso P. Katsoufis[1] · Wacharee Seeherunvong[1] · Jayanthi Chandar[1] · Gaston Zilleruelo[1] · Michael Freundlich[1] · Carolyn L. Abitbol[1]

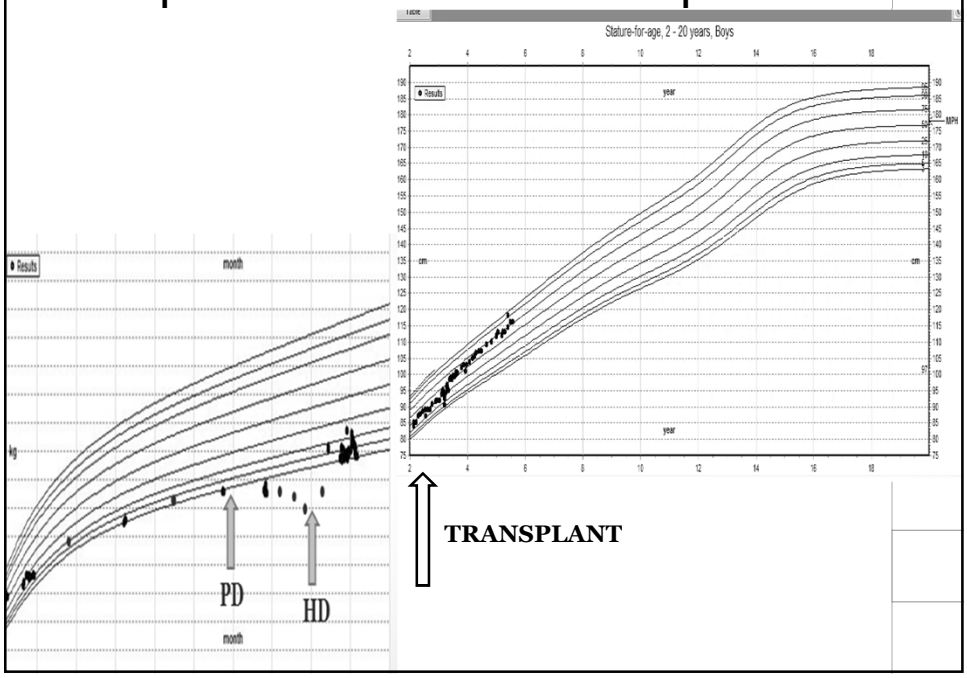
Received: 15 February 2018 / Revised: 10 August 2018 / Accepted: 13 August 2018

- Cinacalcet may be used effectively and safely in infants/small children with refractory sHPT in advanced CKD. Cinacalcet successfully brings iPTH to target level and supports growth when other treatments have been ineffective.

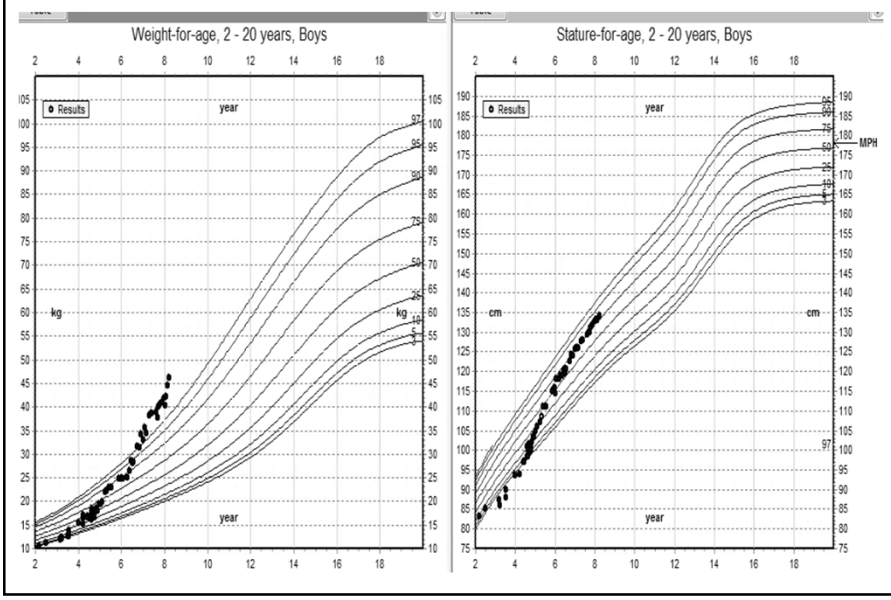
Nutritional Challenges Post-Transplant

- Rapid weight gain and obesity
- Metabolic Syndrome
- NODAT
- Phosphorus and magnesium wasting
- Recurrent UTIs, diarrhea related to antibiotics, and alteration of microbiome→ inflammation
- Failure to thrive

Improved Growth Post-Transplant

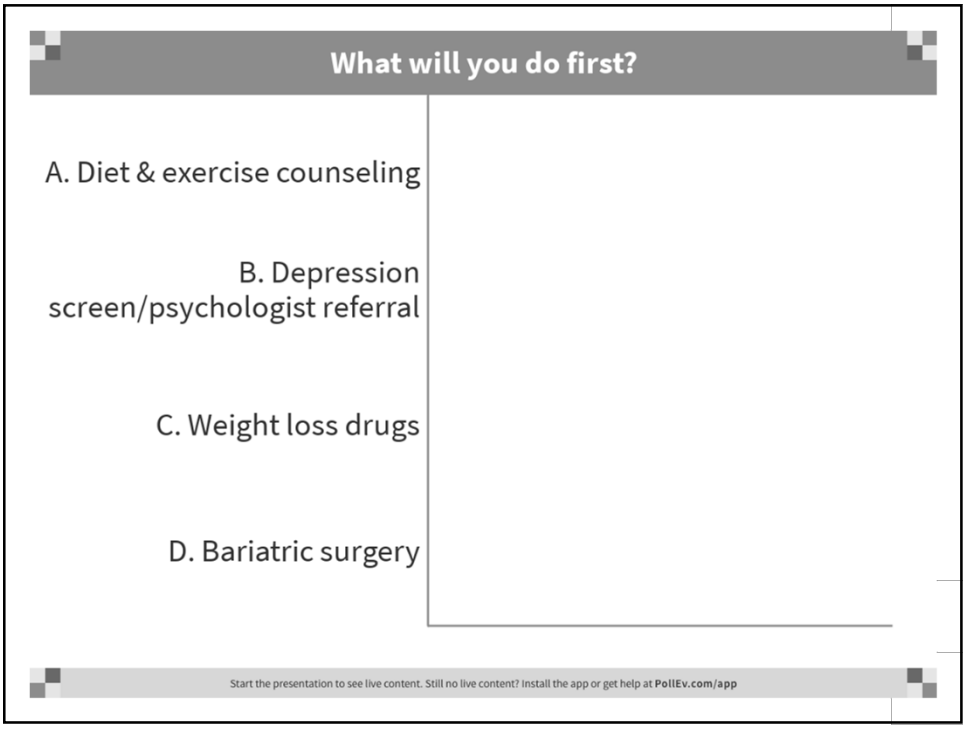


Case: Post-Transplant Obesity

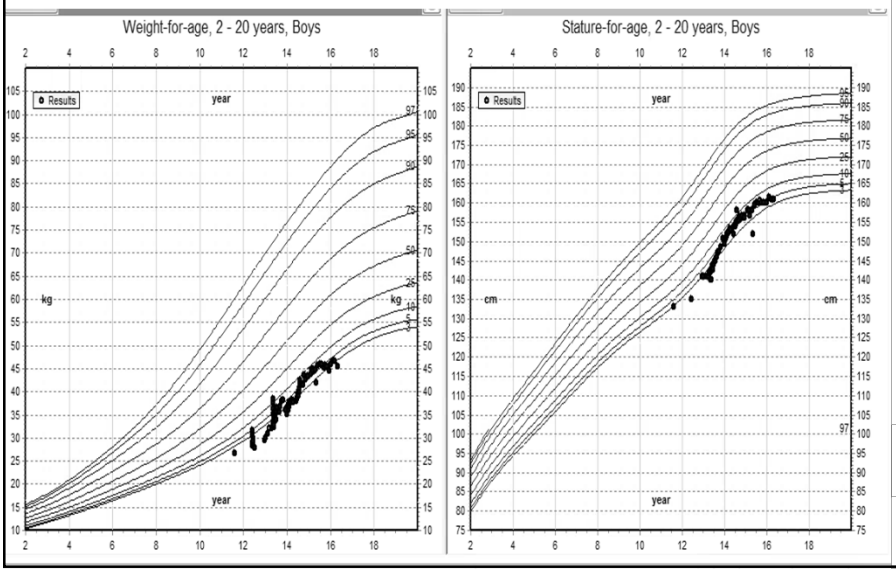


What will you do first?

A. Diet & exercise counseling
B. Depression screening/psychologist referral
C. Weight loss drugs
D. Bariatric surgery



Failure to Thrive Post-transplant



Nutrition and Outcomes

Malnutrition negatively impacts patient outcomes:

- Increased morbidity/mortality
- Increased hospitalization
- Increased risk of infection
- Increased length of stay
- Increased healthcare cost
- Poor cognition
- Decreased quality of life

Early Intervention is KEY!

Mak R. Curr Opin Support Palliat Care. 2016 Dec;10(4):293-297

Optimizing Nutrition

CKD and ESRD

- Ensure adequate protein and caloric intake (GT may be needed)
- Adequate dialysis provision
- Control metabolic acidosis and ROD
- GH therapy

Post-Transplant

- Screen and counsel for obesity and metabolic syndrome
- Screen and manage NODAT and dyslipidemia
- Phos, mag supplementation
- Bone health
- Bariatric surgery

- Vitamin D and other vitamins and micronutrient supplementation
- Promote aerobic and resistance building exercises.
- Screen and manage depression

Conclusions- what we want to avoid:

Born: February 8, 1968
Died: May 28, 2010
Height: 4' 8" (1.42 m)