HEXAGON NUTRITION

Nutrition in CKD

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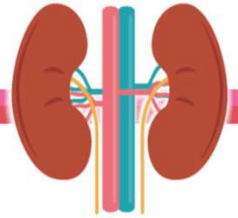
Lilavati Hospital & Research Centre

Agenda



- Prevalence of Malnutrition in CKD patients
- Nutritional screening and assessment of CKD patients
- Nutrition Therapy: Rationale, guidelines and goals
- Oral nutrition supplements for CKD patients: Clinical Evidence
- Indian Experience

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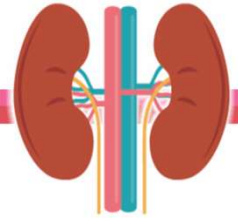
What Is Protein-Energy Wasting (PEW)?



INTERNATIONAL SOCIETY OF RENAL NUTRITION AND METABOLISM

The ISRNM's expert panel defined the term 'protein-energy wasting' (PEW) as a 'state of decreased body stores of protein and energy fuels (body protein and fat masses).'

- PEW or uremic malnutrition is a distinct condition in CKD.
- It is one of the strongest risk factor**s** for morbidity, mortality, and impaired QOL in patients with CKD.
- PEW is often associated with diminished renal functional capacity

Jadeja YP, *et al. Indian Journal of Endocrinology and Metabolism*. 2012;16(2):246-251.

CKD, Chronic kidney disease; QOL, Quality of life; ISRNM, International Society of Renal Nutrition and Metabolism .

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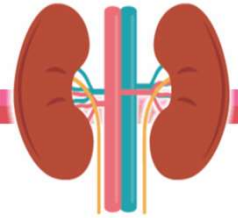
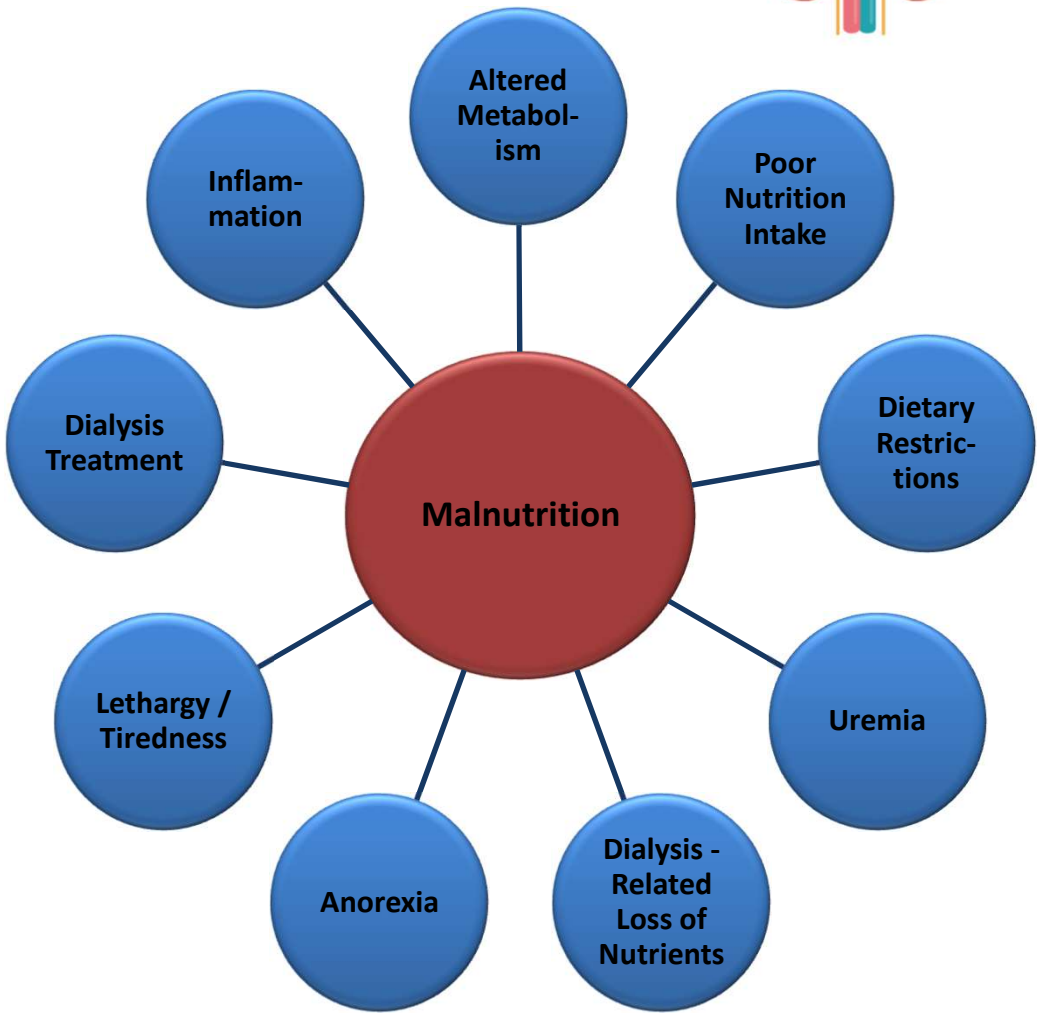
Malnutrition in Chronic Kidney Disease



- High malnutrition rates in Chronic Kidney Disease (CKD) patients
  - 28% to 48% of predialysis patients[1]
  - 18% to 75% of dialysis patients[2]
- Risk for malnutrition increases as CKD progresses
  - Many patients are mal-nourished by the time of dialysis initiation



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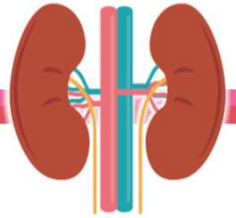
Prevalence of PEW in Pre-dialysis CKD Patients



PEW is prevalent in ~12%-18% of patients with stages 3 and 4 CKD.

- PEW is a common and distinct condition in CKD.[1]
- ~18%–75% of patients with CKD undergoing maintenance dialysis therapy experience PEW.[1]
- The condition is more pronounced in the pre-dialysis phase (stages 4 and 5), especially among the elderly.[2]

- A study conducted by Campbell *et al.* on 53 patients with stage 4 and 5 pre-dialysis CKD reported 12% prevalence of malnourishment.[2]
- Another study, conducted by Sanches *et al.*, among 122 patients with CKD reported 18% prevalence of malnutrition in CKD stages 3 and 4 patients.[3]

1. Jadeja YP, *et al. Indian Journal of Endocrinology and Metabolism*. 2012;16(2):246-251.
2. Campbell KL, *et al. Clin Nutr.* 2008;27(4):537-544
3. Sanches FM, *et al. Am J Kidney Dis.* 2008;52(1):66-73.

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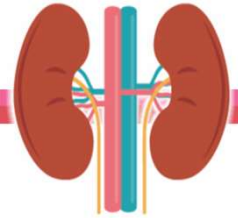
PEW is present in 12-18% of Stages 3 and 4 CKD patients



2 studies reported PEW prevalence up to 18% in patients with early-stage CKD (3 and 4)

- 18% prevalence in CKD Stages 3 and 4 patients in Brazil using SGA (n=122, age 55 ±11)[1]
- 12% prevalence in CKD Stage 4 patients in Australia, using SGA (n=56, age 70 ±14)[2]

Sanches FM, et al. *Am J Kidney Dis.* 2008;52:66-73.
Campbell KL, et al. *Clin Nutr.* 2008;27:537-544.

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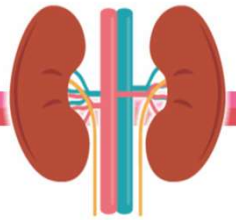
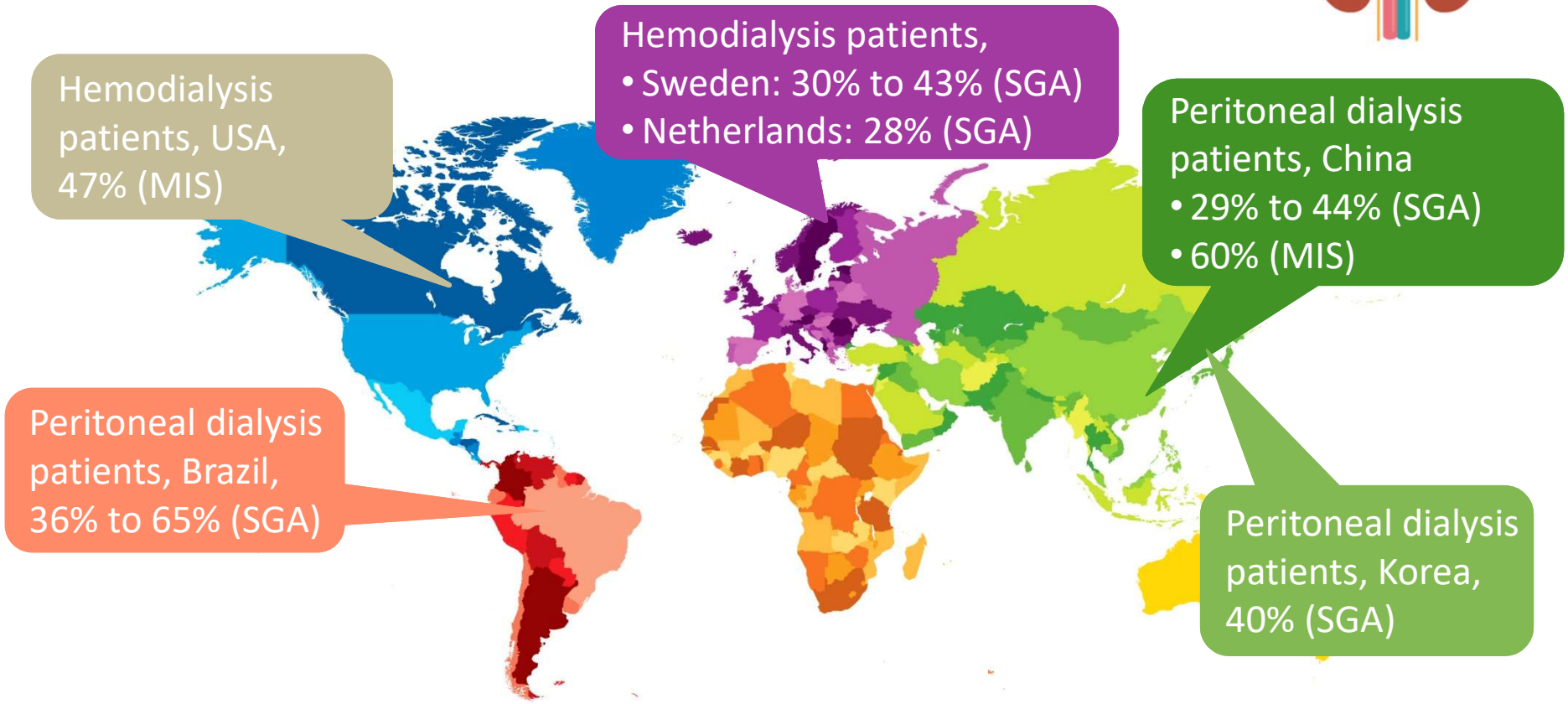
PEW is present in 30% to 65% of dialysis patients around the world





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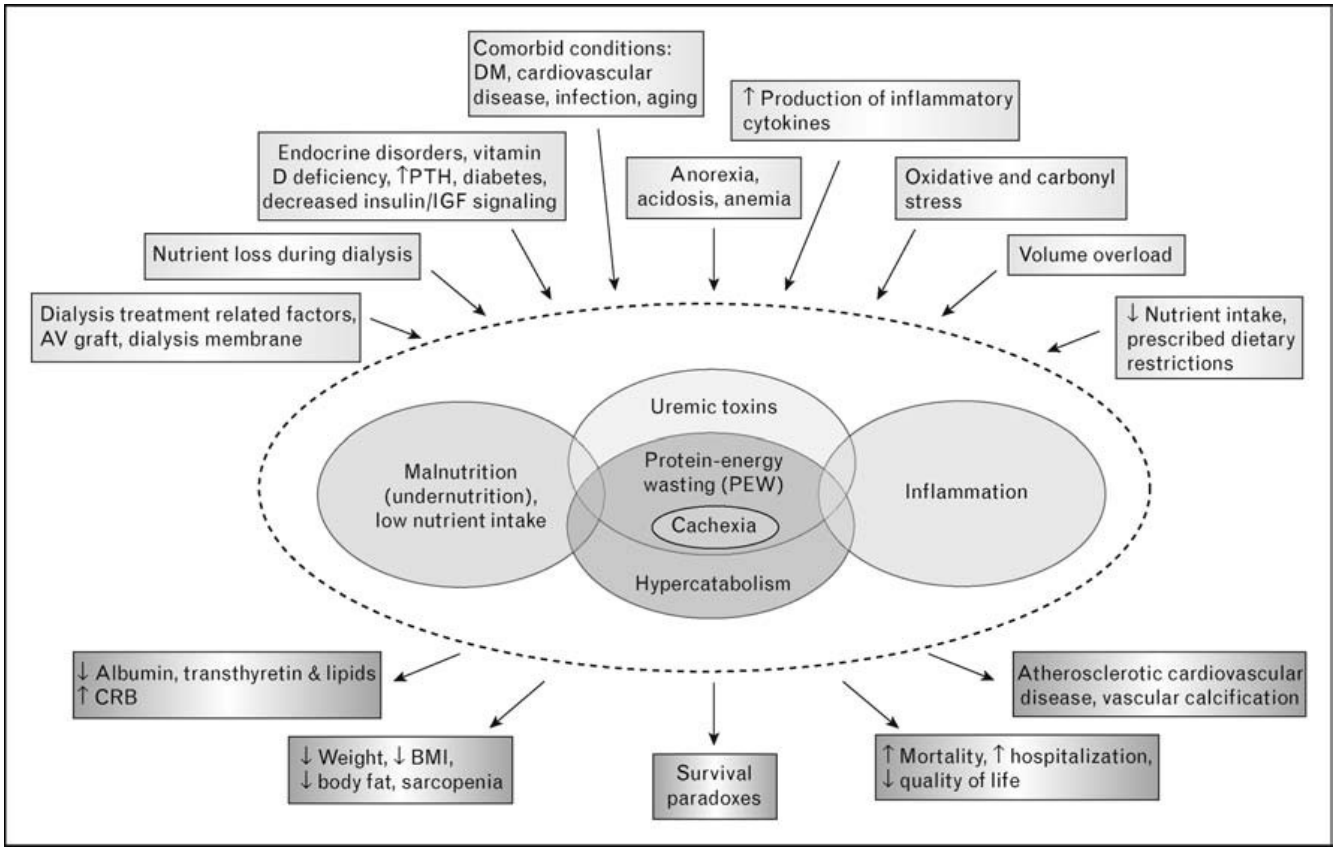
Causes and manifestations of the PEW in kidney disease



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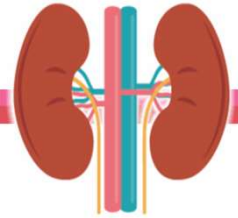
Methods for Evaluating PEW in Pre-dialysis CKD Patients



Evaluation of PEW in Pre-dialysis Patients with CKD

Nutritional Intake
- **Direct:** Dietary recalls and diaries, food-frequency questionnaires
- **Indirect:** Based on urea nitrogen appearance (e.g. 24-h urinary urea collection)

Body Mass and Composition
- **Weight-based measures:** BMI, weight-for-height
- **Skin and muscle anthropometric measurements:** Skinfold thickness, extremity muscle mass
- **Total-body elements:** Total-body K, total-body N_2
- **Imaging, energy-beam, or electrical current methods:** DXA, BIA, NIR, CT, MRI

- **Visceral proteins:** Serum albumin, prealbumin, transferrin
- **Lipids:** Cholesterol, triglycerides, other lipids and lipoproteins
- **Indicators of muscle mass and/or meat or protein intake:** Serum creatinine, urea
- **Growth factors:** IGF-I, leptin
- **Peripheral blood cell count:** lymphocyte count
- **Proinflammatory cytokines:** Serum CRP, TNF-a, IL-6

Indexes or Scales
- **Subjective global assessment:** Conventional or modified for renal failure
- **Malnutrition-**Inflammation Score

Kovesdy CP, et al. *Am J Clin Nutr.* 2013;97(6):1163-1177.

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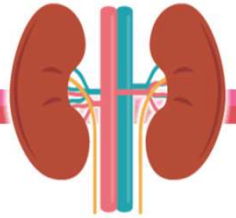
Subjective Global Assessment (SGA) is widely used in CKD



Patient history
- Weight loss, reduced dietary intake
- GI issues, functional capacity

Physical exam
- Muscles, subcutaneous fat edema, ascites

Clinical judgment
- A = well-nourished
- B = at risk or moderately malnourished
- C = severely malnourished

Advantages
- Robust, widely used
- Quick to administer

Limitations
- Requires training
- Based on clinician judgment

Detsky AS, et al. *JPEN J Parenter Enteral Nutr*. 1987;11:8-13.

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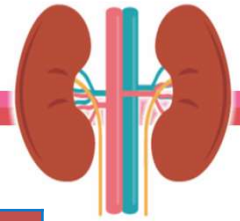
The Malnutrition Screening Tool (MST) is simple and reliable



Malnutrition Screening Tool (MST)	
1. Have you lost weight recently without trying?	
No	0
Unsure	2
If yes, how much weight have you lost?	
0.9 – 6.3 kg	1
6.4 – 10.7 kg	2
10.8 – 15.0 kg	3
> 15 kg	4
Unsure	2
2. Have you been eating poorly because of a decreased appetite?	
No	0
Yes	1

Ferguson M, et al. *Nutrition.* 1999;15:458-464.
Lawson CS, et al. *J Ren Nutr.* 2012;22:499-506.

Subjective Global Assessment (SGA)

SUBJECTIVE GLOBAL ASSESSMENT RATING FORM

Patient Name/ID #: Date:

HISTORY

Overall Rating:

IGHT/WEIGHT CHANGE:

1. **Baseline Wt:** _____(Dry weight from 6 months ago)
   Current Wt: _____(Dry weight today)
   Actual Wt loss/past 6 mo:_____ **% loss:**_____(actual loss ÷ baseline) 1 2 3 4 5 6 7
2. **Weight change over past two weeks:** _____No change
   (Recent significant gain may negate previous loss) _____ Increase
   _____ Decrease 1 2 3 4 5 6 7

DIETARY INTAKE 1 2 3 4 5 6 7

1 No Change_____Adequate_____Inadequate **Duration:**_____
2. Change: Suboptimal Intake____ Full Liquid____ Hypocaloric Liquid____ Starvation____

GASTROINTESTINAL SYMPTOMS

Symptom:	Frequency				Duration							
None_____												
Anorexia	Never	1-2 x wk	2-4 x wk	> 5 x wk	< 2 wks	2 wks	1	2	3	4	5	6	7
Nausea	Never	> 5 x wk	2-4 x wk	1-2 x wk	< 2 wks	2 wks	1	2	3	4	5	6	7
Vomiting	Never	> 5 x wk	2-4 x wk	1-2 x wk	< 2 wks	2 wks	1	2	3	4	5	6	7
Diarrhea	Never	> 5 x wk	2-4 x wk	1-2 x wk	< 2 wks	2 wks	1	2	3	4	5	6	7

FUNCTIONAL CAPACITY 1 2 3 4 5 6 7

_____No Dysfunction **Duration:**_____
_____Change in function
____Difficulty with ambulation
____Difficulty with normal activity (Pt. specific "normal")
____Light activity
____Bed/chair ridden with little or no activity
____Improvement in function

DISEASE STATE/COMORBIDITIES AS RELATED TO NUTRITIONAL NEEDS 1 2 3 4 5 6 7

Primary Diagnosis_____Comorbidities_____
Requirements: Normal_____Increased_____Acute Metabolic Stress:____None____Low____Moderate____High

PHYSICAL EXAM

_____Loss of subcutaneous fat (Below eye, triceps, biceps, chest)
_____Some areas ____All areas 1 2 3 4 5 6 7
_____Muscle wasting (Temple/clavicle/scapula/ribs/quadriceps/calf/knee/interosseous) ____Some areas ____All areas 1 2 3 4 5 6 7
_____Edema (Related to undernutrition, alb usually < 2.8 gm/dl)
_____Ascites (HD only -related to undernutrition)

OVERALL SGA RATING

Very Mild Malnutrition to Well Nourished = "6 or 7" in most categories or significant, continued improvement.

Mild-Moderate Malnutrition = "3, 4, or 5" ratings. No clear indication of normal status or severe malnutrition.

Severely Malnourished = "1 or 2" ratings in most categories/significant physical signs of malnutrition.

Note: The CanUSA study showed that a one unit increase on the seven point SGA rating scale was associated with a 25% decline in relative risk of death

The Malnutrition Screening Tool (MST)

MALNUTRITION INFLAMMATION SCORE (M.I.S.)			
(A) Patients' related medical history:			
1- Change in end dialysis dry weight (overall change in past 3-6 months):			
0	1	2	3
No decrease in dry weight or weight loss <0.5 kg	Minor weight loss (≥0.5 kg but <1 kg)	Weight loss more than one kg but <5%	Weight loss >5%
2- Dietary intake:			
0	1	2	3
Good appetite and no deterioration of the dietary intake pattern	Somewhat sub-optimal solid diet intake	Moderate overall decrease to full liquid diet	Hypo-caloric liquid to starvation
3- Gastrointestinal (GI) symptoms:			
0	1	2	3
No symptoms with good appetite	Mild symptoms, poor appetite or nauseated occasionally	Occasional vomiting or moderate GI symptoms	Frequent diarrhea or vomiting or severe anorexia
4- Functional capacity (nutritionally related functional impairment):			
0	1	2	3
Normal to improved functional capacity, feeling fine	Occasional difficulty with baseline ambulation, or feeling tired frequently	Difficulty with otherwise independent activities (e.g. going to bathroom)	Bed/chair-ridden, or little to no physical activity
5- Co-morbidity including number of years on Dialysis:			
0	1	2	3
On dialysis less than one year and healthy otherwise	Dialyzed for 1-4 years, or mild co-morbidity (excluding MCC*)	Dialyzed >4 years, or moderate co-morbidity (including one MCC*)	Any severe, multiple co-morbidity (2 or more MCC*)
(B) Physical Exam (according to SGA criteria):			
6- Decreased fat stores or loss of subcutaneous fat (below eyes, triceps, biceps, chest):			
0	1	2	3
Normal (no change)	mild	moderate	Severe
7- Signs of muscle wasting (temple, clavicle, scapula, ribs, quadriceps, knee, interosseous):			
0	1	2	3
Normal (no change)	mild	moderate	Severe
(C) Body mass index:			
8- Body mass index: BMI = Wt(kg) / Ht^2(m)			
0	1	2	3
BMI>20 kg/m^2	BMI: 18-19.99 kg/m^2	BMI: 16-17.99 kg/m^2	BMI<16 kg/m^2
(D) Laboratory Parameters:			
9- Serum albumin:			
0	1	2	3
Albumin≥ 4.0 g/dL	Albumin: 3.5-3.9 g/dL	Albumin: 3.0-3.4 g/dL	Albumin: <3.0 g/dL
10- Serum TIBC (total Iron Binding Capacity): ♣			
0	1	2	3
TIBC≥ 250 mg/dL	TIBC: 200-249 mg/dL	TIBC: 150-199 mg/dL	TIBC: <150 mg/dL
Total Score = sum of above 10 components (0-30):			

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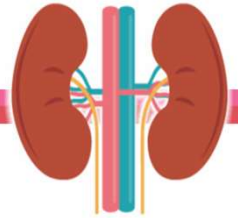
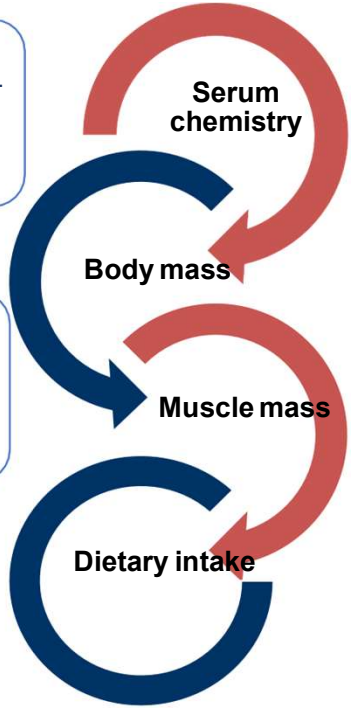
The ISRNM Criteria for Evaluating PEW



- Serum albumin <3.8 g per 100 mL
- Serum cholesterol <100 mg per 100 mL

- Reduced muscle mass 5% over 3 months or 10% over 6 months
- Reduction in mid-arm muscle circumference area by >10%
- Creatinine appearance



- BMI <23 kg/m^2
- Unintentional weight loss over time: 5% over 3 months or 10% over 6 months
- Total body fat percentage <10%

- Unintentional low DPI <0.80 g/kg/day for at least 2 months for dialysis patients or <0.6 g/kg/day for patients with CKD stages 2–5
- Unintentional low DEI <25 kcal/kg/day for at least 2 months

Fouque D, *et al*. *KidneyInt*.2008;73(4):391-398.

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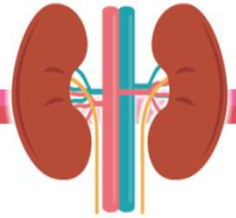
Goals of nutrition therapy for CKD patients



Dietary intake

- Meet protein and energy guidelines, and prevent a decline in nutritional status

Body composition & biomarkers

- Achieve and maintain healthy BMI
- Prevent decline in serum biomarkers

Quality of Life and physical function

- Optimize function, independence, and activities of daily living
- Minimize burden, symptoms, and effects of kidney disease

Cardiovascular health

- Help manage blood pressure, glycemic status, proteinuria

Mortality and morbidity

- Decrease frequent clinic visits and hospitalizations
- Slow rate of progression, maintain residual renal function, improve survival

Ikizler TA, et al. *Kidney Int.* 2013;84:1096-1107.

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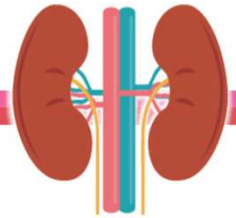
Goals of Nutritional Management



1. Prevention and treatment of undernutrition
2. Correction of uremic metabolic disturbances
3. Prevention of electrolyte disturbances (e.g. hyperkalemia)
4. Attenuation of disease progression through protein or phosphate restriction
5. Preservation of intestinal mucosal integrity and function

Cano N, *et al. Clin Nutr.* 2006;25(2):295-310.

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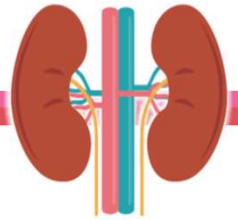
Nutrition therapy in CKD should consider all the nutrients



- Energy
- Water
- Protein
- Carbohydrate
- Lipids
- Sodium
- Potassium
- Phosphorus
- Calcium
- Other elements
- Vitamins

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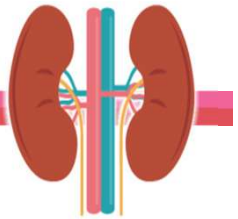
Nutritional Recommendations



	Pre-dialysis CKD	
	KDOQI	**ESPEN**
Energy/Calories	< 60 years:35 kcal/kg/d ≥ 60 years or obese: 30-35 kcal/kg/d	35 kcal/kg/d
Protein	0.6-0.75 g/kg/day 50% High Biological Value (HBV) 48g/d = 24g HBV	GFR 25-70 mL/min: 0.55-0.60 g/kg/d (2/3 HBV) GFR < 25 mL/min: 0.55-0.60 g/kg/d (2/3 HBV) OR 0.28 g/kg/d + EAA or EAA+KA
Sodium		1.8-2.5 g/d
Fluid		
Potassium		1500-2000 mg/d
Phosphorus	800-1000 mg/d < 17 mg/kg IBW/d	600-1000 mg/d

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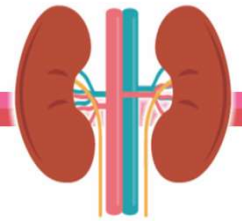
Protein recommendations differ slightly across professional bodies



Professional body	Non-dialysis CKD (g/kg/day)	Hemodialysis (g/kg/day)	Peritoneal dialysis (g/kg/day)
National Kidney Foundation/ KDOQI[1]	0.6-0.75	>1.2	1.2-1.3
British Dietetic Association[2]		>1.1	>1.0-1.2
ESPEN (Nutrition support)[3]	• 0.6-0.8 • Illness: 1.0	• 1.2-1.4 • Illness: >1.5	1.2-1.5
ERA-EDTA (EBPG)[4]		1.1	1.1

Am J Kidney Dis. 2002;39:S1-S266.Cano N, et al.*Clin Nutr.* 2006;25:295-310.
Fouque D, et al. *Nephrol Dial Transplant.* 2007;22:ii45-ii87.

At least 50% of protein intake should be from high biological value protein

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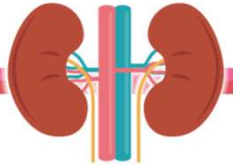
Rationale for Dietary Protein Restriction in Patients With CKD



1. Decrease load on remaining nephrons
2. Improve insulin resistance
3. Reduce oxidant stress
4. Ameliorate proteinuria
5. Reduce serum parathyroid hormone levels
6. Additive effect of angiotensin-converting enzyme inhibitors
7. Decrease likelihood of patient death or delay initiation of dialysis by 40%
8. Improve lipid profile

Fouque D, *et al. Nat Clin Pract Nephrol.* 2007;3(7):383-392.

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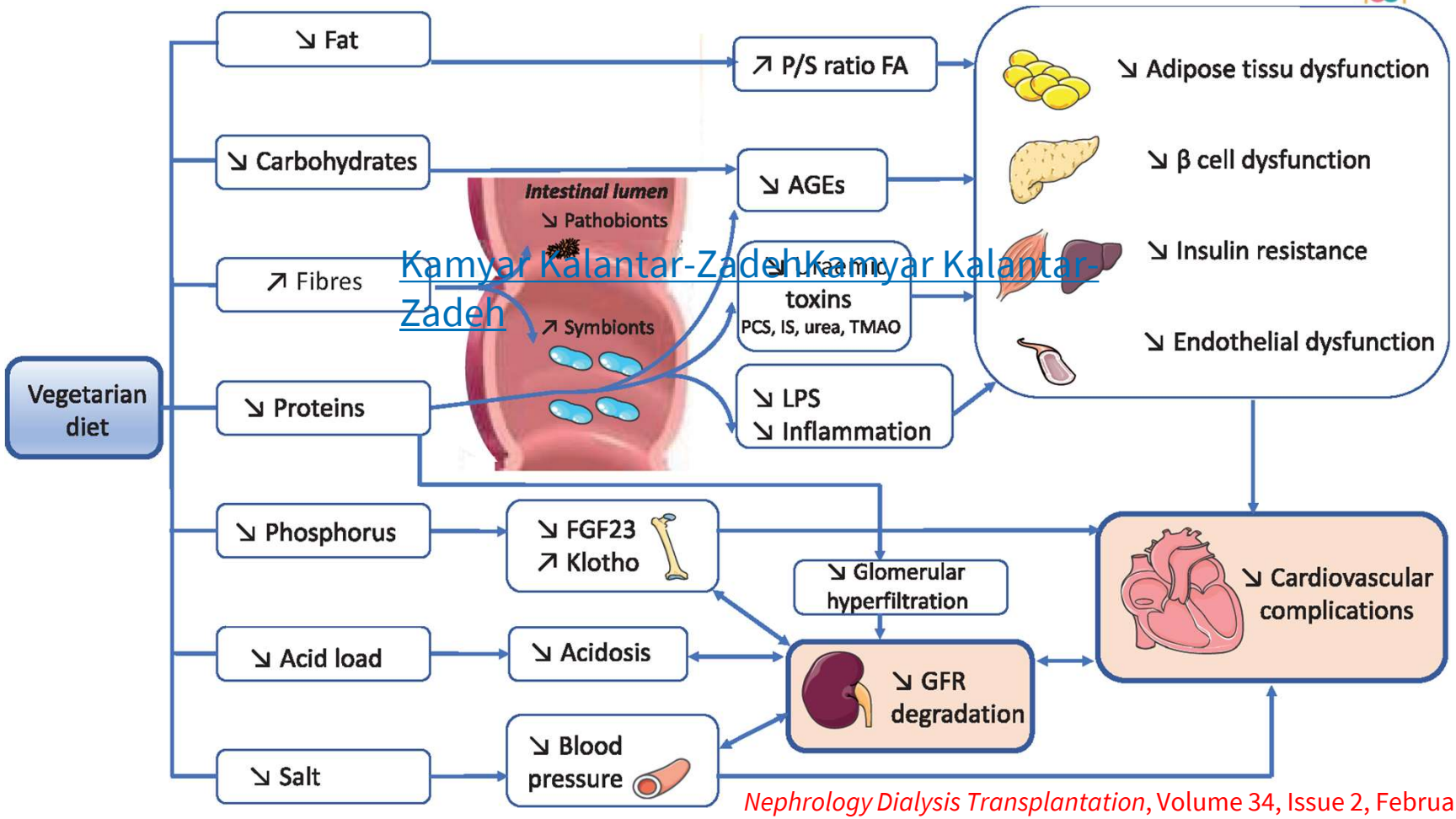
Vegetarian diets and chronic kidney disease



Kamyar Kalantar-Zadeh

Nephrology Dialysis Transplantation, Volume 34, Issue 2, February 2019

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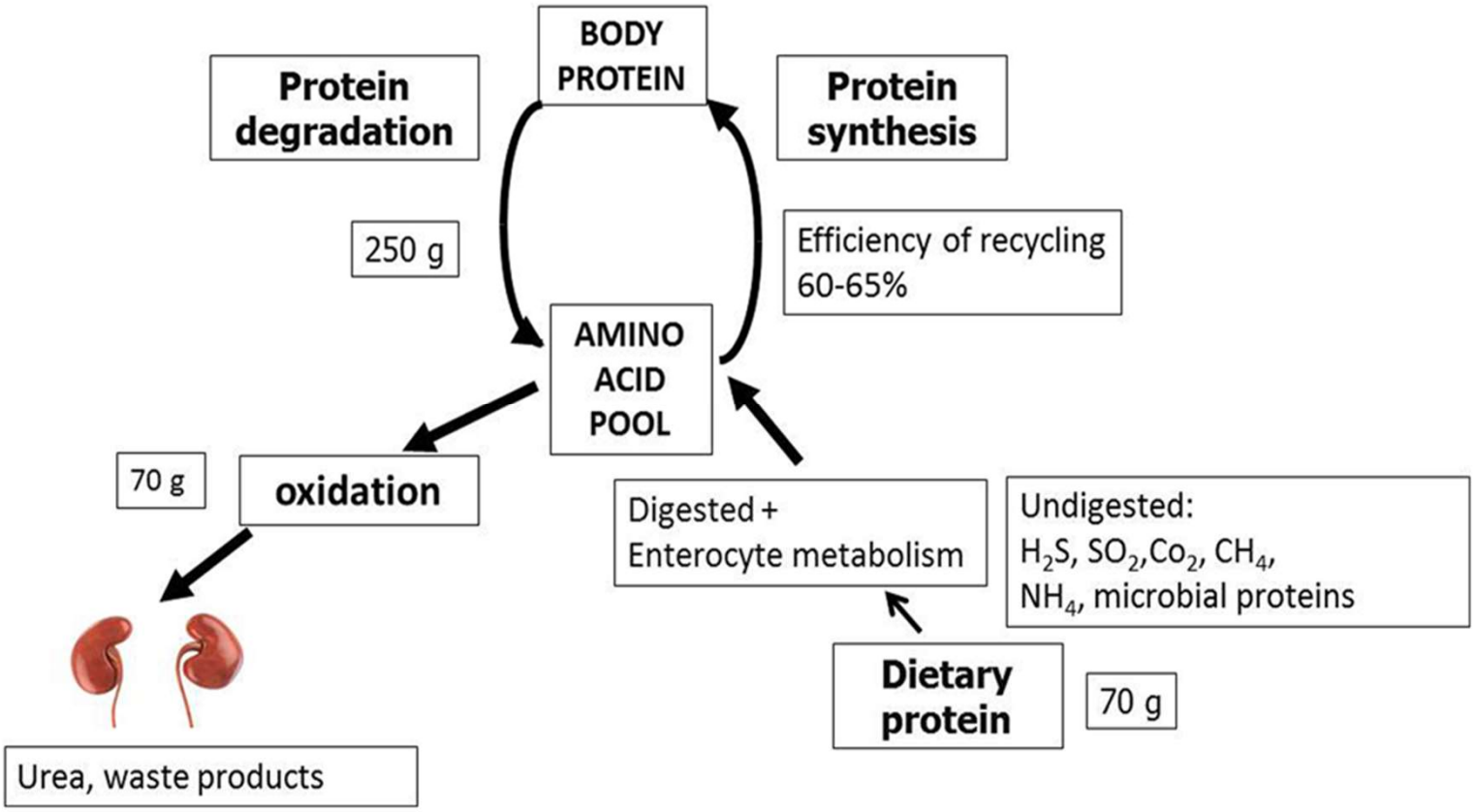
Muscle protein turnover and low-protein diets in patients with chronic kidney disease

Protein turnover at normal (1 g/kg) protein intake in the post-absorptive state in a 70-kg man



Nephrology Dialysis Transplantation, Volume 35, Issue 5, May 2020

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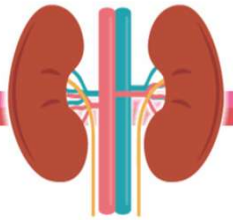
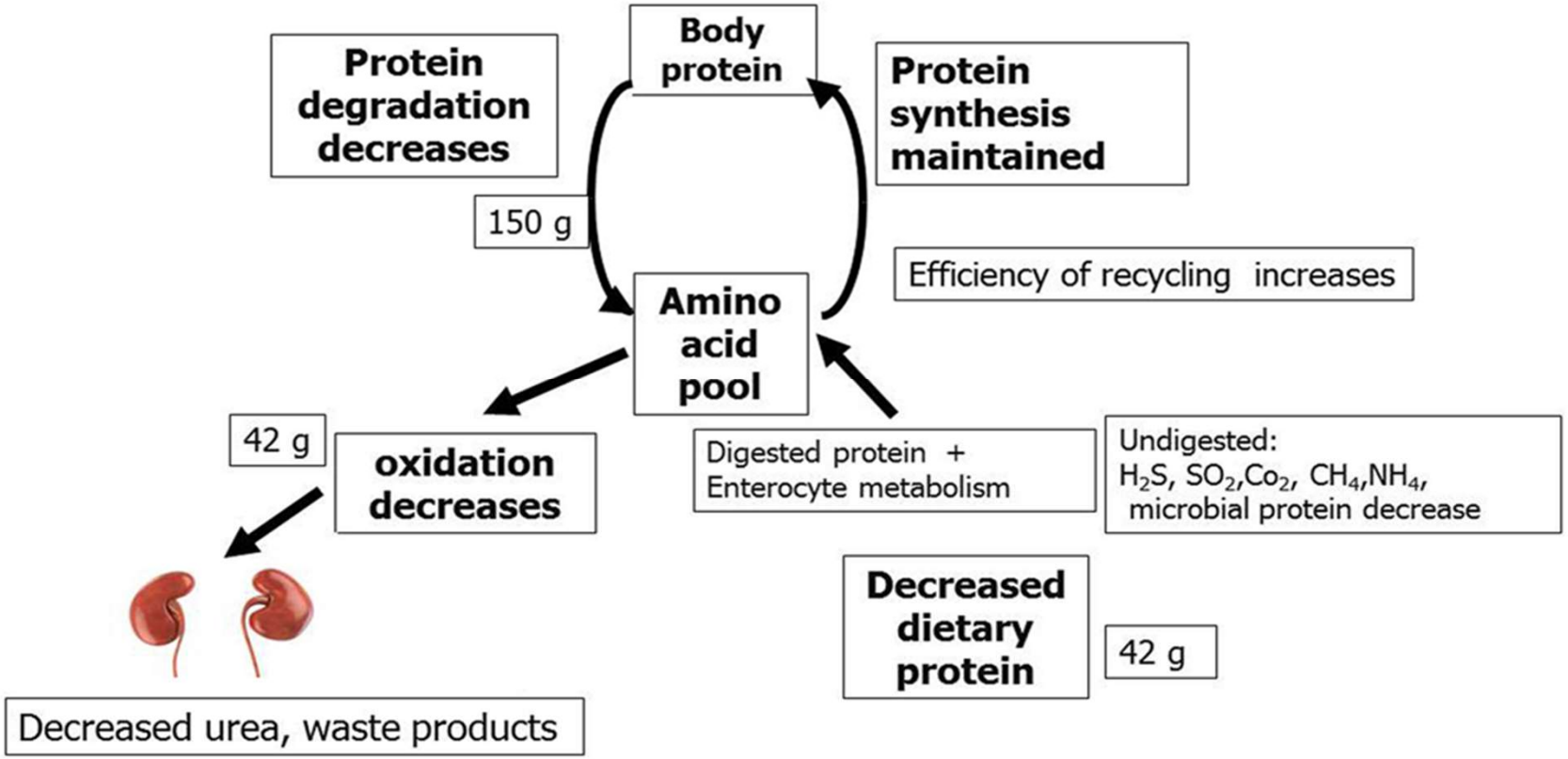
Muscle protein turnover and low-protein diets in patients with chronic kidney disease



Adaptation to a low-protein intake in a 70-kg man



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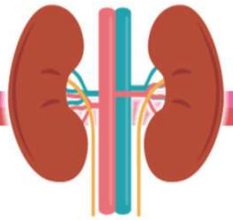
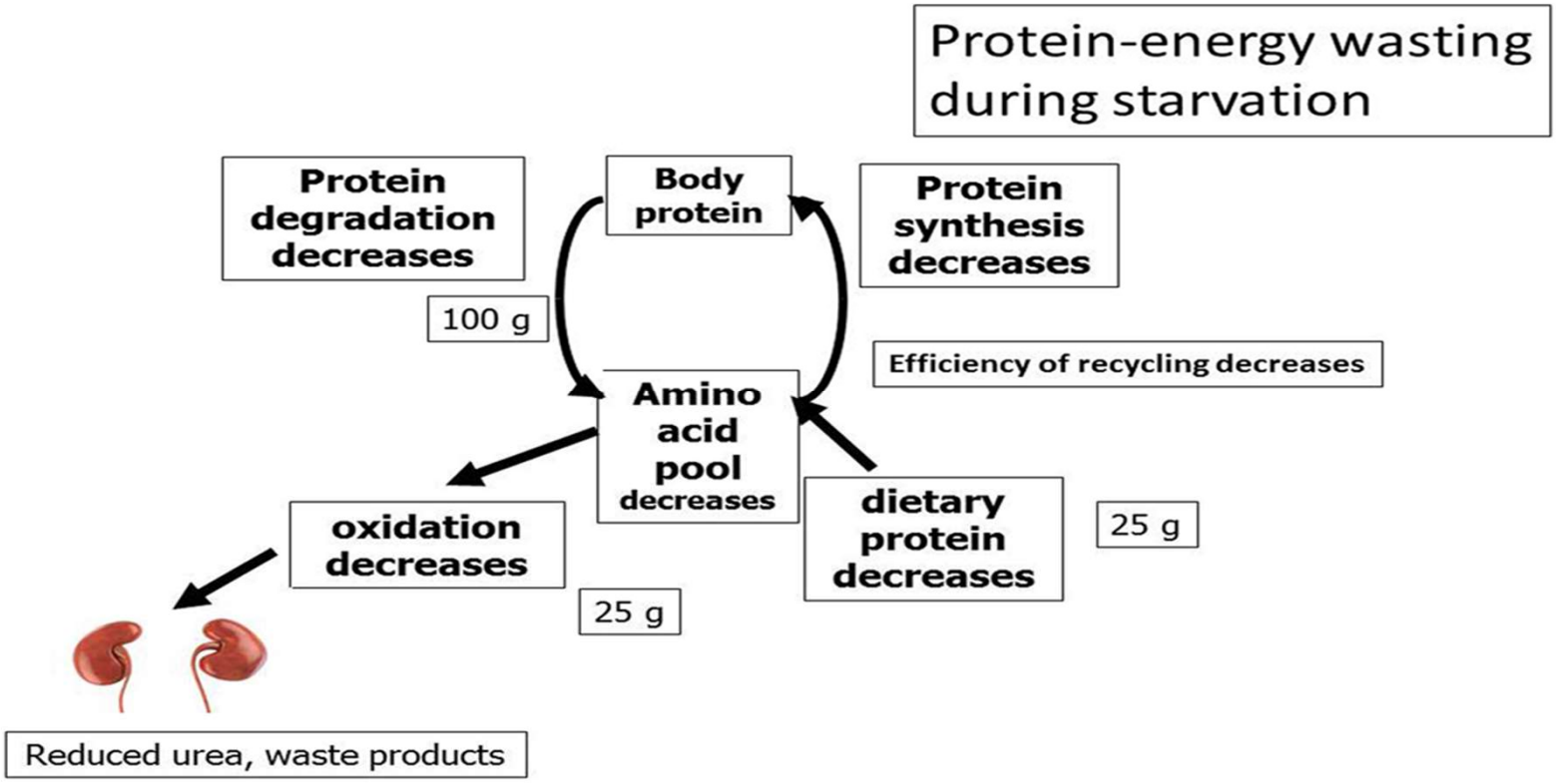


Accommodation to a low-protein intake causes decreased protein synthesis



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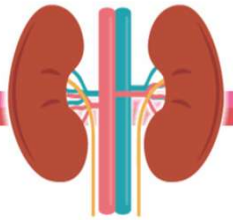
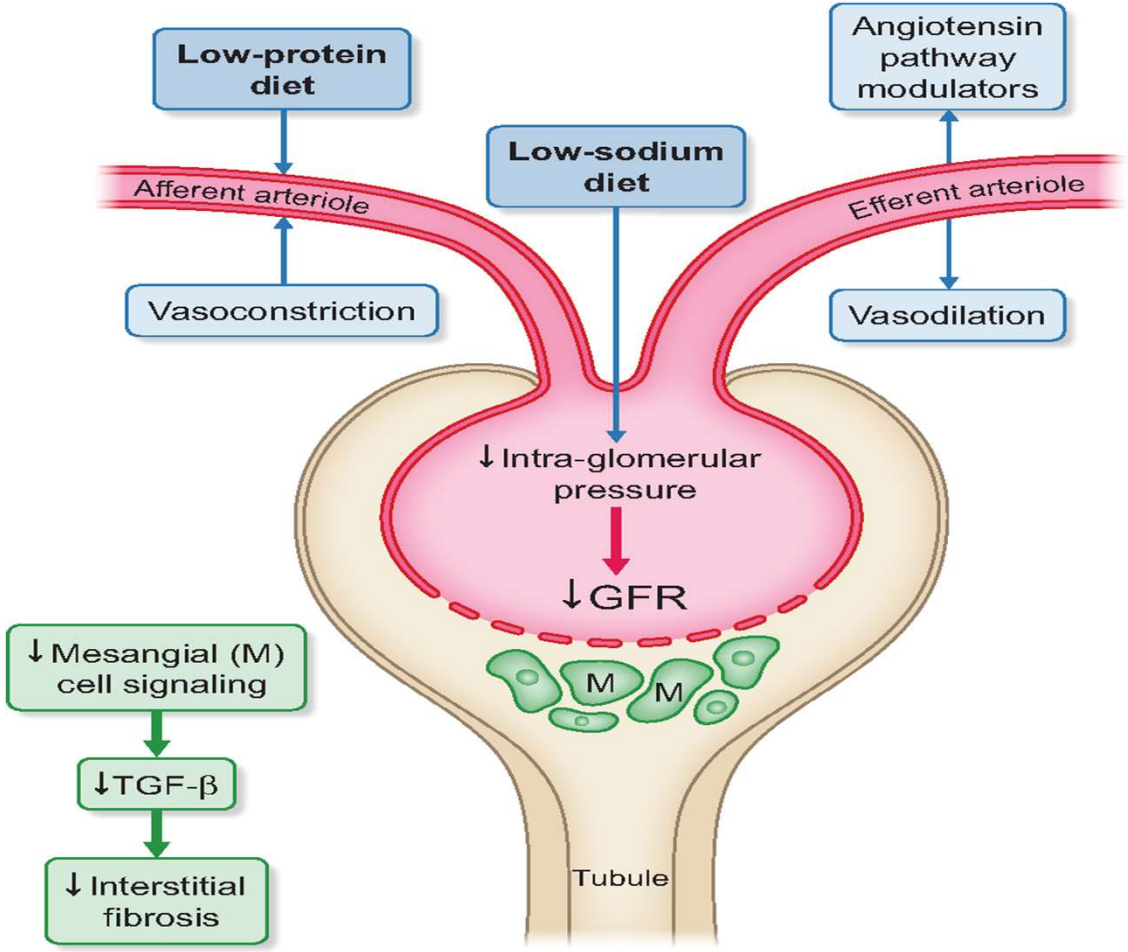
High-protein diet is bad for kidney health: unleashing the taboo





Nephrology Dialysis Transplantation, Volume 35, Issue 1, January 2020

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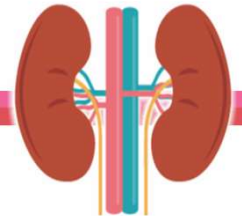
Effects of Protein Restriction on GFR and Kidney Function



- In this study, animals with CKD were exposed to 6% vs. 20% protein intake for 3 months.
- The GFR was found to be 40% lower in animals exposed to high protein load, along with a 5-fold higher protein excretion.
- The mean transcapillary hydraulic pressure difference was substantially and significantly higher in high-protein-load animals indicating that differences in single nephron capillary pressures can determine differences between GFR and protein excretion.

Parameter of kidney function	6% protein diet	20% protein diet	p-value
GFR (mL/min)	0.68 ± 0.13	0.40 ± 0.12	<0.001
Urinary protein excretion (mg/24 hours)	7.0 ± 1.0	36.0 ± 4.0	<0.001
Fractional clearance of albumin ($\theta \times 10^{-5}$)	42 ± 14	264 ± 61	<0.02
Fractional clearance of IgG ($\theta \times 10^{-5}$)	14 ± 6	73 ± 32	<0.05
Mean transcapillary hydraulic pressure difference (mmHg)	47 ± 2	66 ± 4	<0.01

Nath, *et al. J Clin Invest.* 1986;78:1199-1205.

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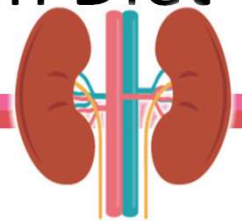
Metabolic Benefits of Low-Protein Diet



Lower-protein diets have metabolic benefits, compared to usual or high-protein diets.

Bernard *et al.* (1996) showed that decreasing protein intake from 1.1 or above to 0.7 g/kg/day improved the lipid profile in CKD stage 3 patients, potentially lowering their CHD risk.[1]

Another metabolic benefit of low-protein diets is the improvement in insulin and glucose metabolism, which are important considerations for the CKD population. Early studies by Gin *et al*. showed that consumption of low-protein diets over 3 months increases insulin clearance and improves oral glucose tolerance test score profiles, when combined with ketoanalogs.[2,3]

Low-protein diets also help in decreasing the phosphate load, compared to usual or high-protein diets. In a study by conducted by Rigalleau *et al.* (1987), both serum phosphorus and iPTH decreased after switching to a low-protein diet for 3 months.[4]

1. Bernard S, *et al. Miner Electrolyte Metab.* 1996;22(1-3):143-146.
2. Gin H, *et al. Am J Clin Nutr.* 1994;59(3):663-666.
3. Gin H, *et al. Metabolism*. 1987;36(11):1080-1085.
4. Rigalleau V, *et al. Am J Clin Nutr.* 1997;65(5):1512-1516.

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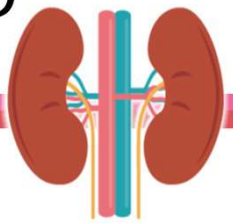
Major Issues Associated With Dietary Protein Restriction in Patients With CKD



Compliance is not easy. Patients seldom adhere to dietary prescriptions.

Worsening nutrition status

Major concerns associated with dietary protein restriction in patients with CKD

Require frequent monitoring by skilled personnel

Need to change diet after initiation of dialysis

Bellizzi V, *et al. BMC Nephrol.* 2016;17(1):77.

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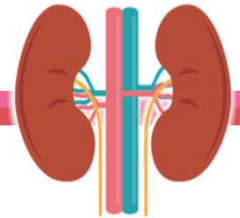
Protein restriction may delay GFR decline by an average of 0.5 mL/min/year



Meta-analysis of low-protein diet (LPD) studies

- 13 RCTs were included in analysis
- 11 non-RCTs were also analyzed and compared
- The reduction in GFR was less in RCTs compared to non-RCTs
- Low-protein diet reduced GFR decline by 0.5 mL/min/year
- The reduction in GFR was greater in diabetic patients
- Authors concluded that protein restriction has a positive effect, but it has not been translated into clinical benefits

Kasiske BL, et al. *Am J Kidney Dis.* 1998;31:954-961.

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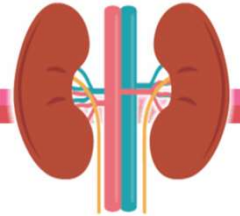
High-protein diet is bad for kidney health: unleashing the taboo : Kamyar Kalantar - et al



Normal kidney function (eGFR >60[a]) and no proteinuria but at higher CKD risk,	Mild to moderate CKD (eGFR 30–<60[a]) without substantial proteinuria (<0.3 g/day)[c]	Advanced CKD (eGFR <30[a]) or any CKD with substantial proteinuria (>0.3 g/day)[c]	Transitioning to dialysis therapy with good RKF, including incremental dialysis preparation	Prevalent dialysis therapy or any CKD stage with existing or imminent PEW
<1.0 g/kg/day, increase proportion of plant-based proteins	<1.0 g/kg/day (consider 0.6–0.8 if eGFR <45 mL/min and fast progression)	0.6–0.8 g/kg/day including 50% HBV or <0.6 g/kg/day with the addition of EAA/KA	0.6–0.8 g/kg/day on nondialysis days (e.g. incremental dialysis) and >1.0 g/kg/day on dialysis days	1.2–1.4 g/kg/day, may require >1.5 g/kg/day if hypercatabolic

Nephrology Dialysis Transplantation, Volume 35, Issue 1, January 20202007;22:ii45-ii87.

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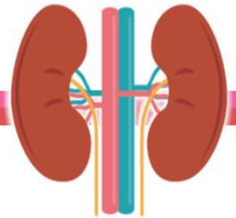
Adequate energy intake helps to maintain nitrogen balance



Early & pre-dialysis CKD

- **Stage1 to 2**: Energy requirements are the same as the general population
- **Stages 3 to 5**: 30-35 kcal/kg of ideal or adjusted body weight/day (age dependent)

Dialysis

- **Stage 5**: 30-35 kcal/kg of ideal or adjusted body weight/day (age dependent)

National Kidney Foundation. *Am J Kidney Dis.* 2000;35:S17-S104.
National Kidney Foundation. *Am J Kidney Dis.* 2002;39:S1-S266.

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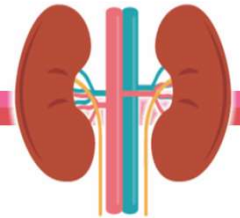
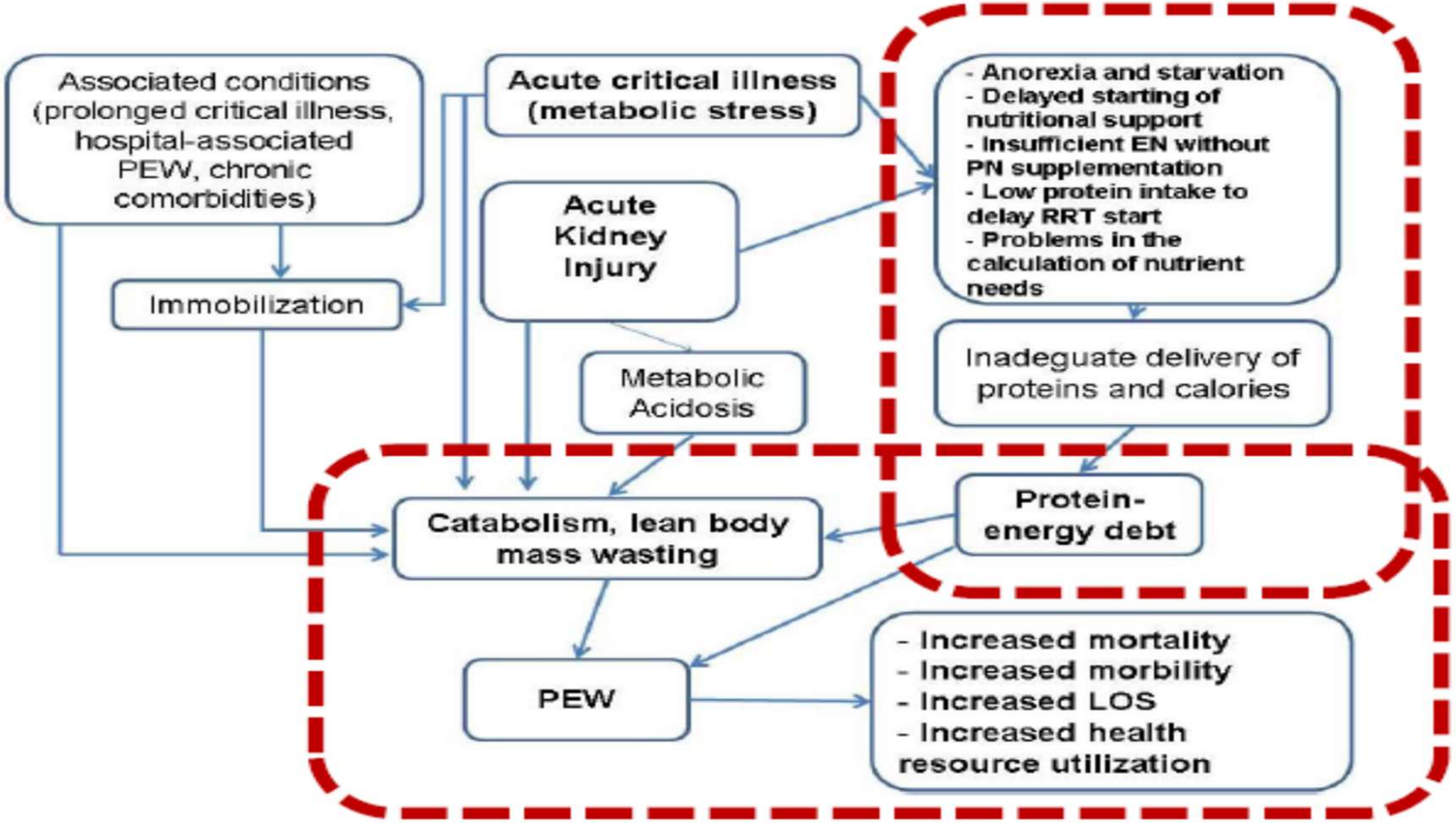
Why high Kcal





Fiaccadori E et al., Curr Opin Clin Nutr Metab Care 2013; 16:217-224

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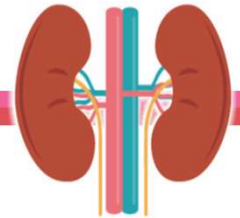
Reducing sodium intake reduces blood pressure

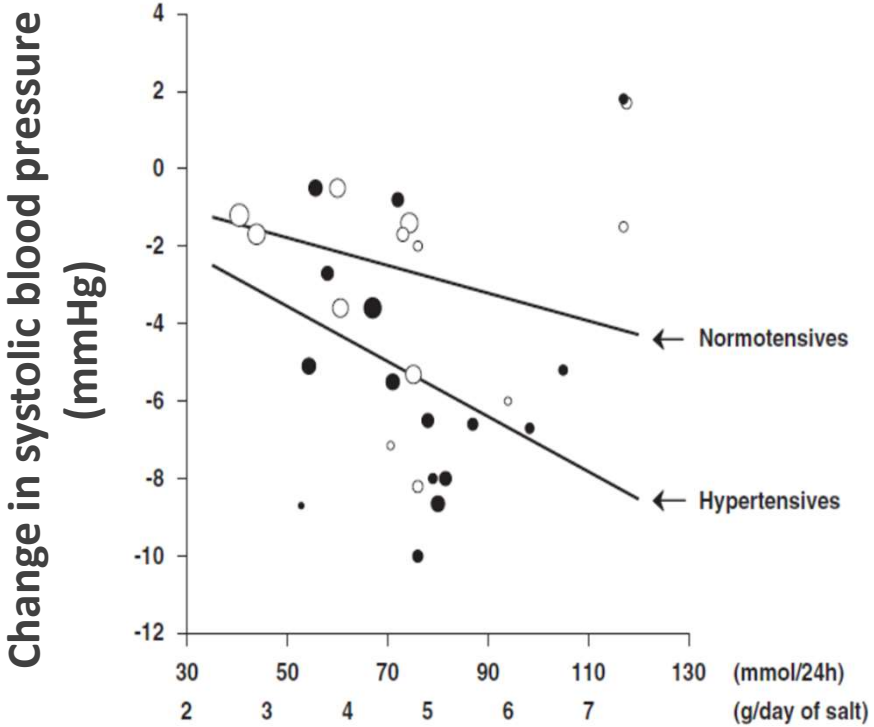


Target intake for sodium: 80-100 mmol (<2.4 g)/day (~6 g salt/day)

Benefits:

- Blood pressure control
- Fluid control
- Residual renal function protection
- Possible cardiovascular benefits

Dose-response to salt reduction



Meta-analysis of Modest Salt Reduction Trials of 1 month or longer

He FJ, et al. *Prog Cardiovasc Dis.* 2010;52:363-382.

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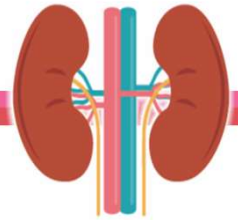
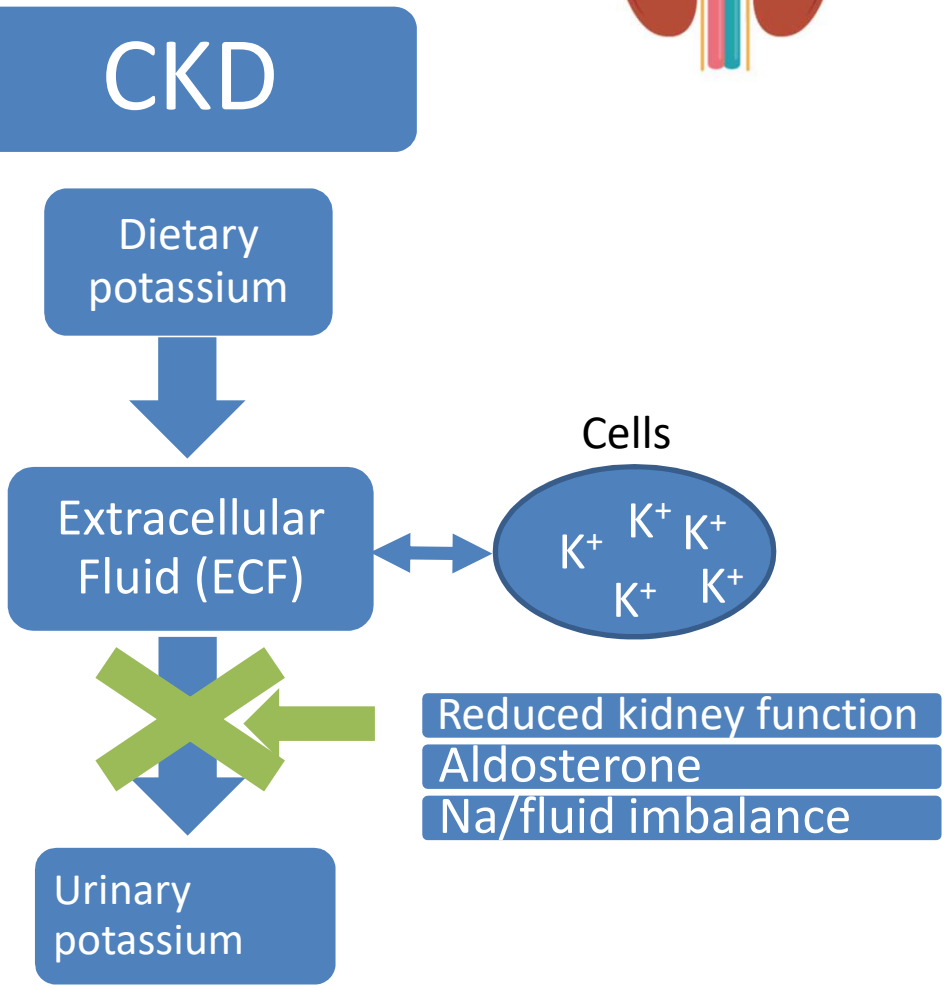
Potassium intake should be restricted as kidney function



High levels of potassium (K) may be the result of:

- Excessive intake
- Medications
  - ACE inhibitors, ARBs, MRBs
- Inadequate dialysis
- Decreased residual renal function
- Acidosis
- Constipation

Potassium (K) intake should be ≤ 2 g/day



National Kidney Foundation. *Am J Kidney Dis.* 2000;35:. S17-S104

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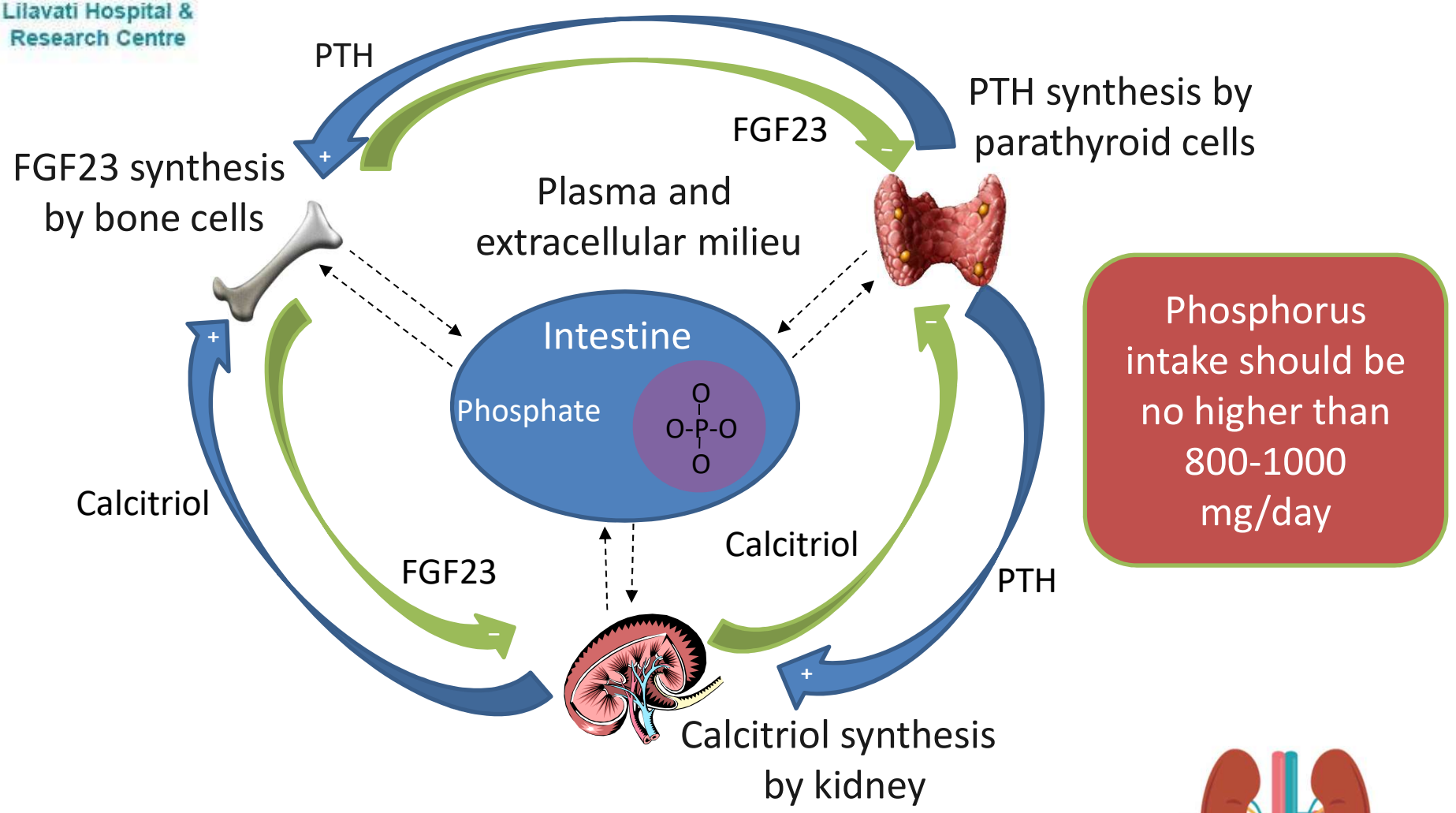
Serum phosphorus levels typically rise as renal function declines



Phosphorus intake should be no higher than 800-1000 mg/day

Torres PA, et al. *Kidney Int.* 2011;80:443-445.

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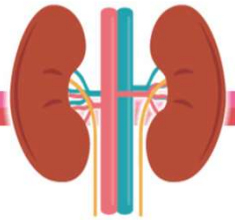
Kamyar Kalantar-Zadeh etal - Understanding Sources of Dietary Phosphorus in the Treatment of Patients with Chronic Kidney Disease



- high dietary phosphorus may worsen hyperparathyroidism and renal osteodystrophy, promote vascular calcification and cardiovascular events, and increase mortality

Source	Examples	Phos Content*	Phos Type	Phos Absorbed**
Plant-based foods	Most fruits and vegetables	↓	Organic phytate or phytic acid	< 50%
	Nuts, seeds, legumes	↑		
Animal-based foods	Meat, fish, poultry, dairy products, eggs	↑	Organic phosphate	40 – 60%
Processed or enhanced foods	Certain beverages, processed meats and cheeses, bakery mixes, frozen meals, fast foods	↑↑	Inorganic phosphate salts (PO_4 additives)	> 90%

Clin J Am Soc Nephrol 5: 519 –530, 2010. doi: 10.2215/CJN.06080809

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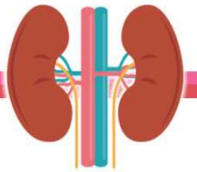
Nutritional Recommendations



	Post-dialysis/ Dialysis CKD	
	K/DOQI	**ESPEN**
Energy/Calories	< 60 years: 35 kcal/kg/d ≥ 60 years or obese: 30-35 kcal/kg/d	35 kcal/kg/d
Protein	1.2 g/kg/d 50% High Biological Value	1.2-1.4 g/kg IBW/d
Sodium	—	1.8-2.5 g/d
Fluid	—	1000 mL + urine volume
Potassium	—	2000-2500 mg/d
Phosphorus	800-1000 mg/d < 17 mg/kg IBW or SBW/d	800-1000 mg/d

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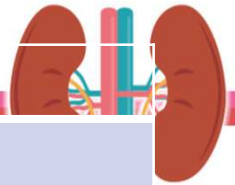
Nutritional requirements in AKI



Protein	**1.5 g/kg/day** Add 0.2 g/kg/day, because 10–15% of infused amino acids in parenteral nutrition during RRT are lost in the dialysate/ultrafiltrate
Amino acids	**Both esential and non-essential amino acids are needed** • Certain amino acids, such as glutamine, are shown to be effective in animal and small pilot studies
Energy Non-protein calories	20 to 30 kcals/kg/day No more than 25 kcal/kg/day
Carbohydrates	2/3 of non-protein calories as glucose • not > 5 g/kg/day according to ESPEN • not > 7 g/kg/day according to KDIGO
Fat	1/3 of non-protein calories as fat • 1.0-1.5 g/kg/day, 18-24 hour infusion, according to ESPEN • 0.8-1.0 g/kg/day according to KDIGO

1. Cano NJ, et al. *Clin Nutr.* 2009;28:401-414.
2. (KDIGO). *Kidney Int.* 2009;2:1-140.

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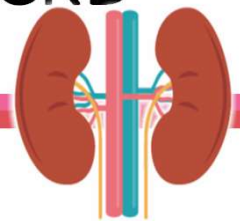
Summary of requirements for CKD



	Non-dialysis CKD	Hemodialysis	Peritoneal Dialysis
Energy	30-35 kcal/kg/day	35 kcal/kg/day	35 kcal/kg/day including kcal from dialysate
Protein	0.6-0.8 g/kg/day Illness: 1.0 g/kg	>1.2 g/kg/day	>1.2 g/kg/day Peritonitis: >1.5 g/kg
Sodium	80-100 mmol/day	80-100 mmol/day	80-100 mmol/day
Potassium	<1 mmol/kg if elevated	<1 mmol/kg if elevated	Not usually an issue
Phosphorus	800-1000 mg & binders if elevated	Binders if elevated	Binders if elevated

1. National Kidney Foundation. *Am J Kidney Dis.* 2000;35:S17-S104.
2. National Kidney Foundation. *Am J Kidney Dis.* 2002;39:S1-S266.
3. Fouque D, et al. *Nephrol Dial Transplant.* 2007;22:ii45-ii87.
4. Cano N, et al. *Clin Nutr.* 2006;25:295-310.

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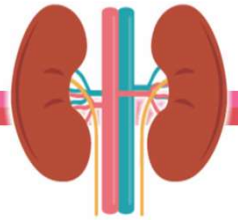
Clinical case 1 (Pre-HD)



- 78 M
- HTN - 40 yrs.
- Hypothyroidism
- Primary Membranous nephropathy – treated with cyclosporin 50mg BD, Prednisolone 20mg OD.

- Presented with wt loss , anorexia
- O/E : dehydrated

- BUN 111.4
- SC -4.58
- CRP-- 40.22 PCT– 0.55
- UA—18.18
- S Albumin —3.0

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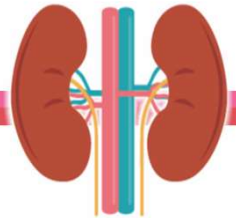
Clinical case 1 (Pre-HD)



- Cyclosporin dose reduction led to gradual decrease of S. Creat but oral intake remained poor.

- At this time patient was started with ONS .
- Initially patient was started with small doses but eventually doses were increased
- Patient general condition gradually improved along with increase in S. Albumin and decrease in S. Creatinine.

- Patient was discharged with S. Creatinine of 0.9 mg/dl

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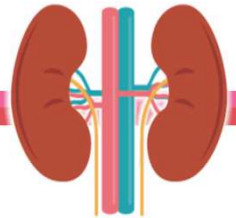
Clinical case 2 (Post - HD)



- 63 yrs M
- CKD 5 HD (NKD – DKD), 2 / wk , R – IJV TCC
- DM, HTN, IHD, Hypothyroid
- Presented with Altered Sensorium and hypoglycemia

- Other relevant history :
- Living alone , smoker + ,
- Recurrent hospitalisations for infections
- Repeated changes in dry wt over past 6 months

- O/E
- Clinically dry, cachectic, scratch marks over trunk and legs

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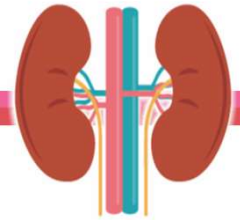
Clinical case 2 (Post - HD)



- Labs :
- Hb : 7
- BUN : 124
- Creat : 12
- Na/K/Cl/HCO3 : 129/6/98/18
- Ca : 7.8
- Po4: 9
- UA : 8
- Protein : 5
- Albumin : 2.2
- Globulin : 2.8

Cause of PEW

- Inadequate dialysis (twice / wk dialysis)
- Underlying inflammation (HD from TCC)
- Acidosis
- Anemia
- Hyperphosphetemia
- Smoking
- Depression

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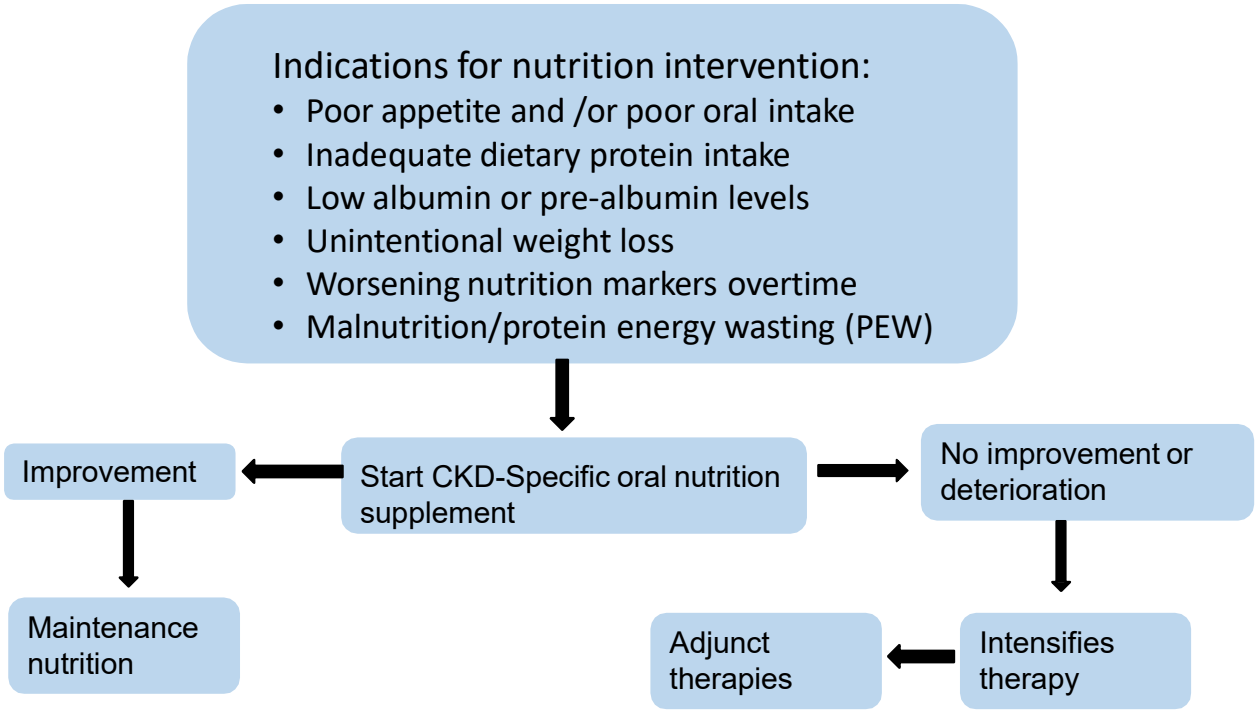
ISRNM Guidelines

The ISRNM treatment Guidelines for PEW in CKD



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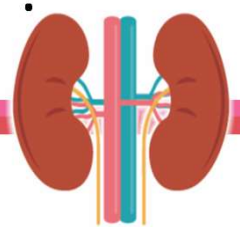
What next if patient has PEW?



- Correct cause of fever
- Try to correct nausea vomiting
- Treat diarrhea
- Encourage patient to eat all the food at home
- Correct Pancreatitis if present
- Correct ileus if present
- Dialysis the patient well
- Improve nutritional status

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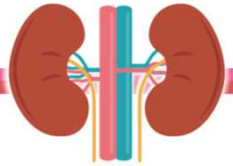
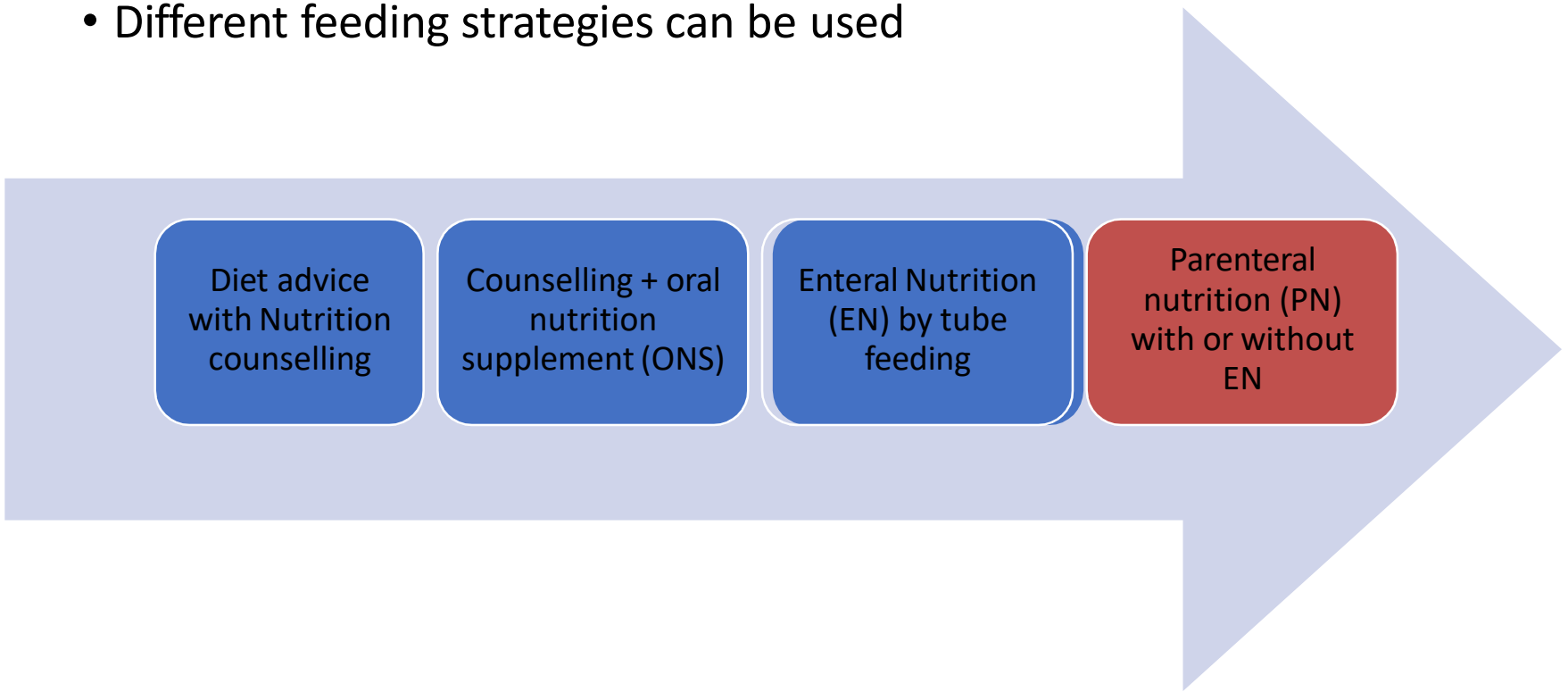
Nutritional Strategies in PEW



- Different feeding strategies can be used



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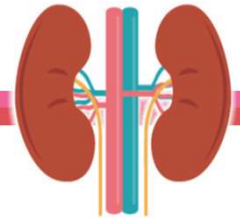
Who should receive Nutrition Intervention



Expert recommendations:

	KDOQI[1]	ESPEN[2]	EBPG[3]
Nutrition Support	Individuals undergoing maintenance dialysis who are unable to meet their protein and energy requirements with food intake for an extended period of time should receive nutritional support	Special formula products for HD treatment can be useful, especially in malnourished patients who are not able to increase their nutrient intake	Oral nutritional supplements should be prescribed if nutritional counseling does not achieve an increase in nutrient intake to a level that covers minimum recommendations. Products specifically designed for dialysis patients should be prescribed

1. NKF K/DOQI Clinical practice guidelines for nutrition in chronic renal failure. *AJKD*, 2000; 35:S1-S140. 2. Cano N, et al. *Clin Nutr*, 2006; 25:295-310.
3. Fouque D, et al. *NDT*, 2007; 22(suppl 2):ii45-ii87.

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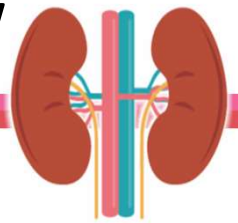
Oral nutrition supplementation provides benefits for managing PEW



- Lower mortality
- Improved quality of life scores
- Increased body weight and maintenance of lean body mass
- Improved anti-anemia response to erythropoietin
- Patient-preferred: lower fluid need & phosphate-binder use
- Improved serum albumin, serum prealbumin levels
- Increased calorie and protein intake
- Improved nutritional status (SGA)
- Well-tolerated with less constipation, better compliance, safety, and effectiveness

Over the past 2 decades, 11 studies have shown outcome benefits of ONS therapy for managing PEW in CKD patients on dialysis

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Other Nutritional Requirements in CKD

CKD patients have specific vitamin & trace mineral needs

Water soluble	Fat soluble vitamins	Trace elements
Vitamins B1, B6, C and folate are removed by dialysis and should be replaced with an appropriate supplement or dietary source	Usually only vitamin D is supplemented when below normal	Zinc, selenium and magnesium supplementation are recommended Oral iron supplements are not recommended IV infusion in ESRD

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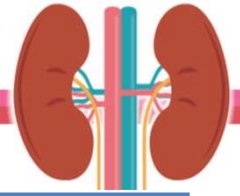
Meta-analysis indicates ONS improves albumin and energy and protein intake



Study	Population	ONS Treatment	Effect (95% CI)
Shah et al, 1999[2]	Non-RCT, HD patients, mean age, 54.5	3 servings /wk for 3 months	**0.73 (-0.11 to 1.57)**
Beutler et al, 1997[3]	Non-RCT, HD patients, mean age ~66	1-2 servings/day for 4 months	**0.16 (-1.03 to 1.35)**
Sharma et al, 2002[4]	RCT, HD patients, mean age ~30	2 sachets daily for 1 month	**0.37 (-0.05 to 0.79)**
		All Non RCT studies	**0.35 (-0.05 to 0.75)**
		All studies	**0.42 (0.06 to 0.78)**

1. Stratton RJ, et al. *Am J Kidney Dis.* 2005;46:387-405.
2. Shah NA, et al. *J Am Soc Nephrol.* 1999;10:303A.
3. Beutler KT, et al. *J Ren Nutr.* 1997;7:77-82.
4. Sharma M, et al. *J Ren Nutr.* 2002;12:229-237.

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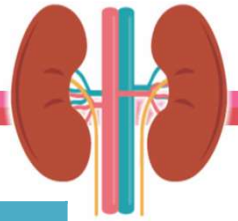
Commercial enteral formulas are preferred over blenderized foods



Liquidized formulas	Commercial formulas
Unknown nutritional content	Complete / balanced nutrition
Unknown osmolality	Known osmolality
May contain lactose	Lactose- and gluten-free
Poor microbial quality	Sterile
High viscosity	Established tube flow
May not be culturally sensitive	Kosher, Halal

Campbell SM. *Nutr Clin Pract.* 2006;21:411-415.

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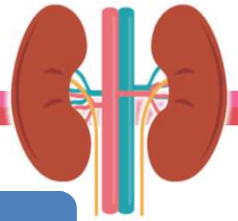
Features of renal-specific ONS



Complete formula

- Macronutrients and micronutrients

Meets physiological needs

- Stage of CKD, dialyzed or non-dialyzed

Multiple formats

- Liquid, pudding, bar

Adaptable, to improve compliance and tolerability

- Mix with other foods/beverages; use as a milk replacement
- Appealing serving suggestions (e.g., ice cream)
- Use as an ingredient in mealtime recipes

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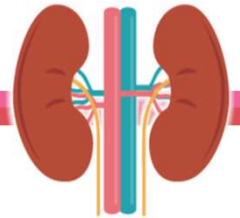
If patient does not take orally?



ALWAYS USE THE GUT

- Put Ryles tube or PEG feeding
- If GI tract is a problem, give intra-dialytic parentral nutrition
- Can give anti-depressants
- Can give anabolic steroids
- Can give appetite stimulants

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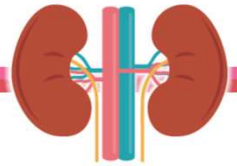
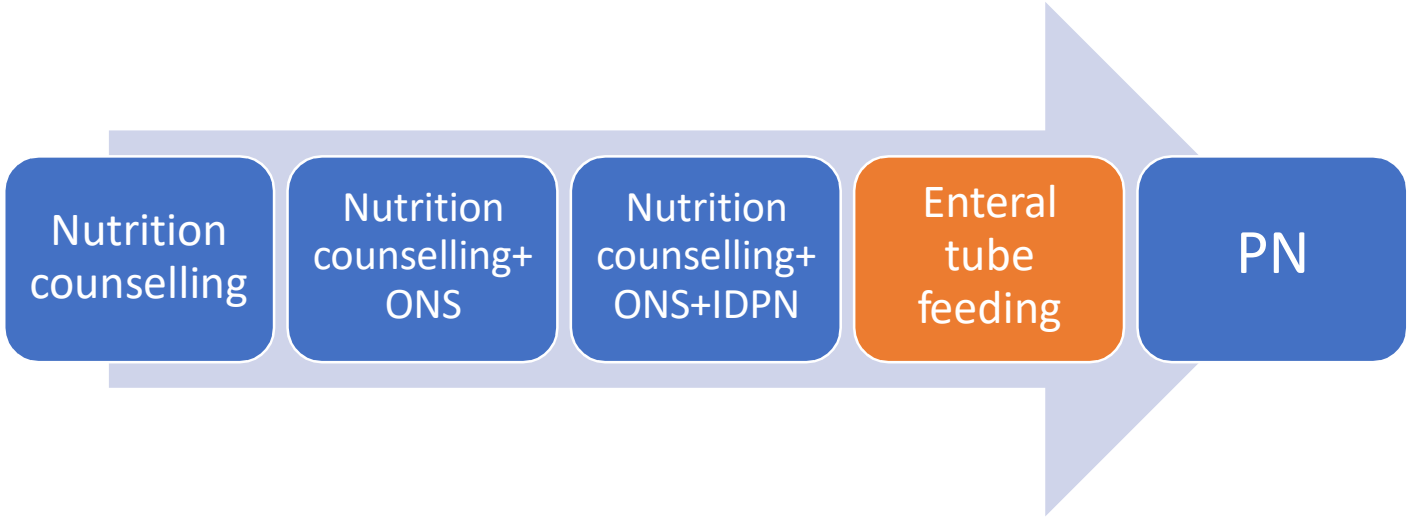
If Oral intake remains insufficient, use tube feeding





- Enteral tube feeding is the next step for those patients who have a functional intestinal tract but are unable to meet nutrition needs with food + ONS

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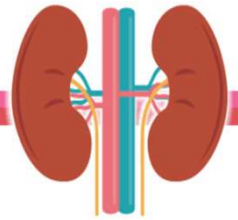
If Oral intake remains insufficient, use tube feeding



- Use standard PN formula for CKD patients when PN is indicated
  - Data are not available for kidney-specific PN formula
- Provide vitamins and trace elements intravenously when PN is the only source nutrition
  - Monitor for accumulation of vitamin A and trace elements to avoid toxicities if receiving PN for more than 2 weeks

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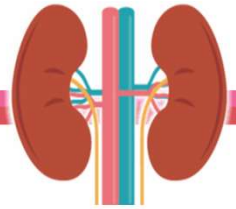
Proposed Algorithm for Enteral Nutritional Support in Patients with CKD



Periodic nutritional assessment and dietary counseling of patients with CKD:
- Dry weight, laboratory values (albumin, prealbumin), muscle mass, nutritional scores (SGA, MIS), appetite, diet (DPI, DEI, K, P, fluid, Na, vitamins, other micronutrients)

↓

Indications for nutritional interventions:
- Poor appetite and/or poor oral intake
- Unintentional loss of dry weight, sarcopenia
- Albumin <40 g/l or prealbumin <300 mg/l
- MIS ≥5 or SGA in malnourished range
- DPI <1.0 (CKD stage 5) or <0.5 g/kg per day (CKD stages 1–4)

↓

Start CKD-specific oral nutritional supplementation 1–2 servings per day:
- CKD stages 1–4 and RTR: DPI target of ~0.6 g/kg per day (including ± amino acids and/or ketoanalogues)
- CKD stage 5D: DPI target of >1.2 g/kg per day using oral supplements at home and in-center meals and oral supplements during dialysis treatment

↓

Kalantar-Zadeh K et al. Nat Rev Nephrol. 2011;7:369-384

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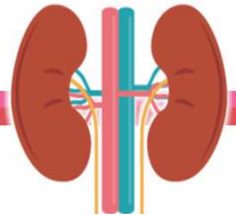
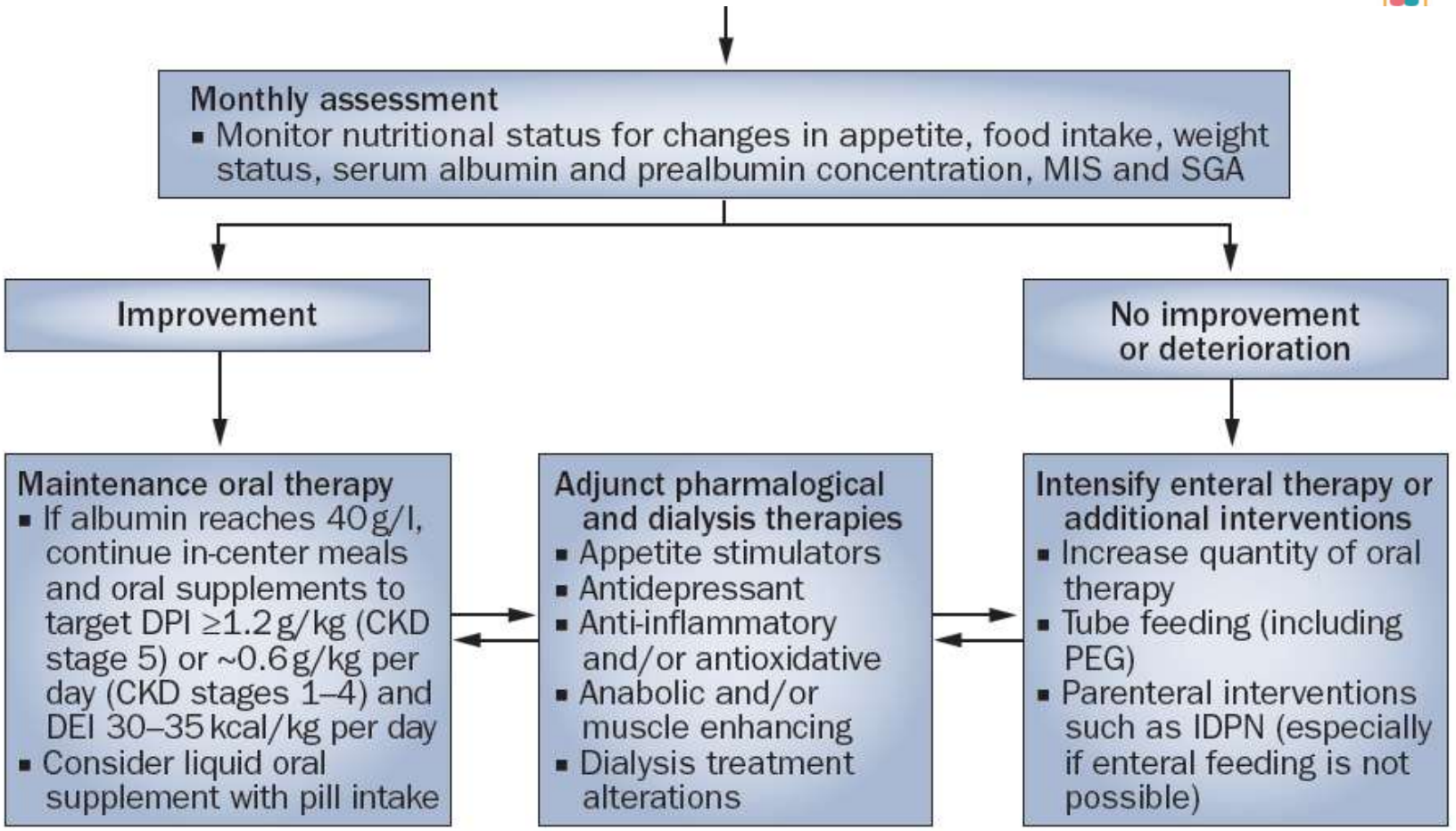
Proposed Algorithm for Enteral Nutritional Support in Patients with CKD





Kalantar-Zadeh K et al. Nat Rev Nephrol. 2011;7:369-384

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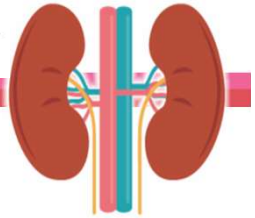
ONS supplementation in Hemodialyzed patients: Indian Experience

30 JOURNAL OF THE ASSOCIATION OF PHYSICIANS OF INDIA - VOL 62 - DECEMBER, 2014

ORIGINAL ARTICLE

Therapeutic Effects of Oral Nutritional Supplements during Haemodialysis : Physician's Experience

Arun B Shah*, Rupin A Shah**, Anup Chaudhari***, Neelam Shinde****



- **Objectives:** To evaluate the effects of predialytic oral nutritional supplementation in chronic kidney disease (CKD) patients on maintenance haemodialysis (MHD)
- **Methods:** Nepro HP® was provided to 77 CKD patients on maintenance haemodialysis (MHD) over 3 months. Efficacy parameters were improvement in albumin levels, weight and haemoglobin levels; safety parameters were serum potassium and phosphorus values; other parameters were SGA and MIS scores.

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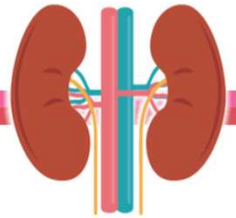
Therapeutic effects of ONS during Hemo-Dialysis



- **Objectives:** To evaluate the effects of peri-dialytic oral nutritional supplementation in chronic kidney disease (CKD) patients on maintenance haemodialysis (MHD)
- **Methods: Renal Specific Formula** was provided to 77 CKD patients on maintenance haemodialysis (MHD) over 3 months.
- *Data was collected over a period of 3 months from patients of outpatient haemodialysis unit located in Mumbai, India*.

Arun Shah et al, Journal of Associations of Physicians of India, Dec 2014

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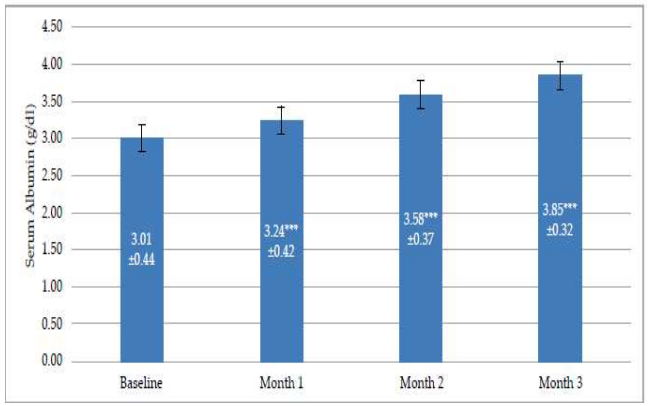
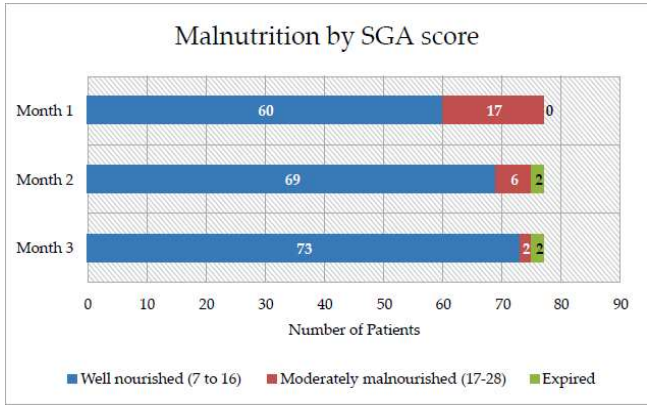
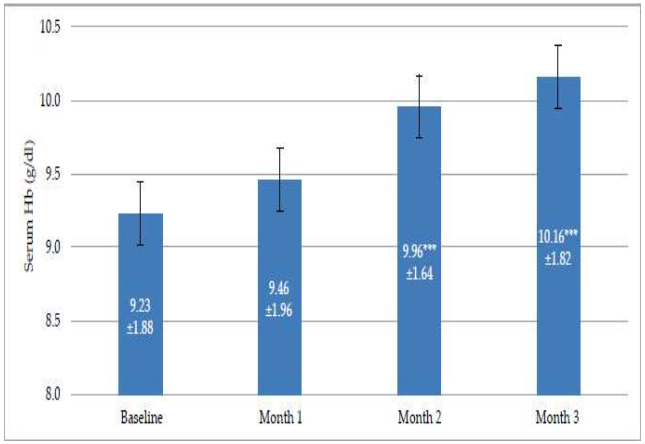
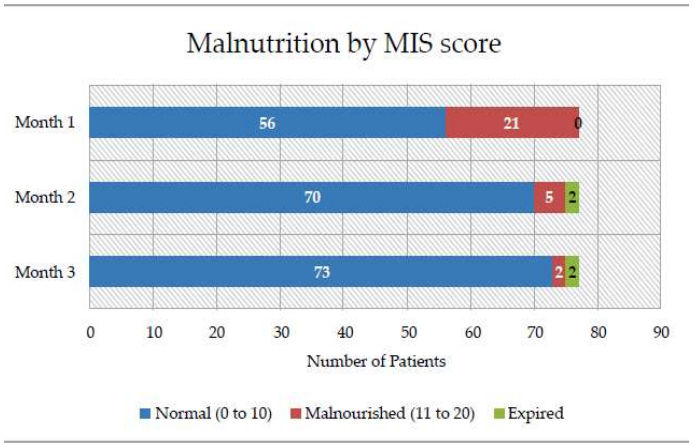
Conclusion: Predialytic oral supplementation with **Renal Specific Formula** improves nutritional status of CKD patients on MHD.









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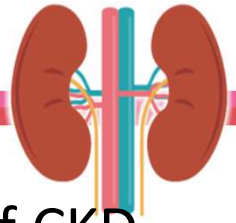
Observation of Indian CKD Population – My Experience



- They are poorly informed about nutrition in all stages of CKD
- Patients tend to listen to relatives & friends and other patients about diet
- Most of the patients continue pre-dialysis low protein diet
- They do not have concept about calories
- They believe higher the creatinine on dialysis, poorer the health
- They are ill informed about value of serum albumin
- Quite often , albumin is not included in follow up investigations on dialysis
- Nutrition should be emphasized as valuable as Haemoglobin for quality of life

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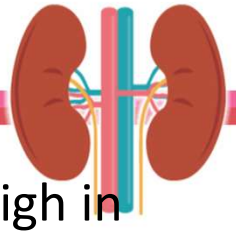
Take Home Message



- The prevalence of PEW is high in CKD and its is particularly high in those who are on dialysis
- The etiology of PEW is complex, however hypercatabolism and under-nutrition are central to its development
- Dietary guidelines are restrictive and can be confusing for the patients
- Regular nutrition screening followed by assessment is fundamental to integrating nutritional therapy into practice
- Benefit of nutritional supplementation in CKD are reflected in the improvements in outcomes

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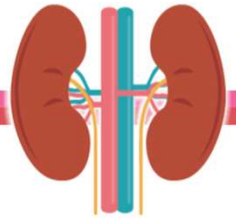
Why nutrition?



- In the treatment of CKD, what are important milestones which have benefited patients in last 50 years?

1. Control of hypertension & diabetes
2. Dialysis therapy
3. Transplantation
4. Erythropoietin therapy for correction of anemia
5. **RENAL NUTRITION to improve QUALITY OF LIFE (QOL)**

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Thank you