Pediatric Renal Nutrition Challenges In Practice

- Yasmin Gamal El Gendy
- A Prof Pediatrics And Clinical Nutrition
- Ain Shams University
- ESPEN diploma.IBCLC

Why We Are Here Today?

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Paediatric Renal Dietitians And Paediatric Nephrologists From 8 Countries

Multidisciplinary team

- Nephrologist
- Nutritionist
- Psychotherapist
- Nurse
- Social worker
- caregiver

What is our goals?

Optimal growth

Prevent malnutrition

Avoidance of uremic toxicity, metabolic abnormalities

Reduction of the risk of chronic morbidities and mortality in adulthood.

Best quality of life

Best Practice...

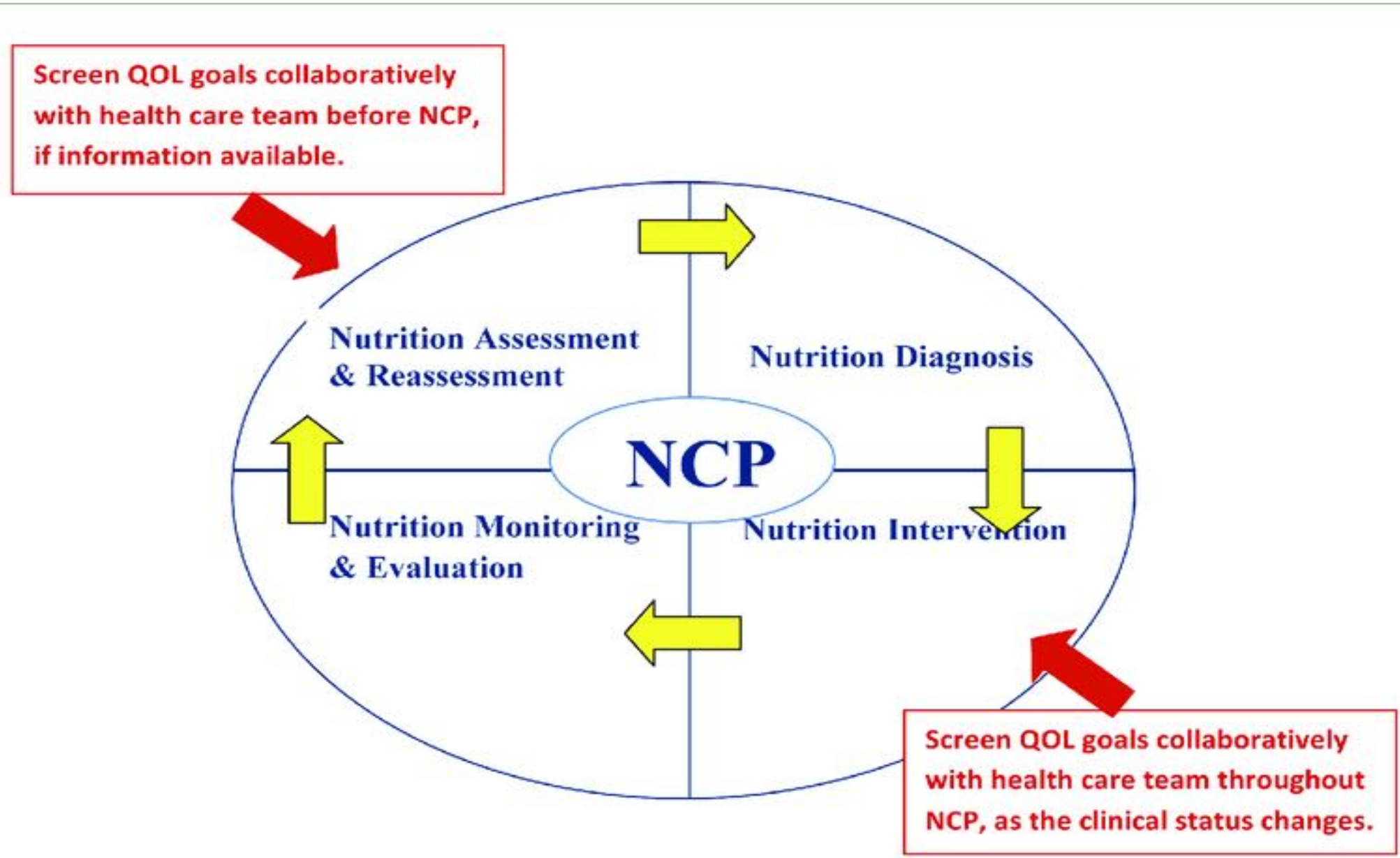
SCREENING

AT RISK

ASSESSMENT

Technical	• Vomiting/Reflux • Delayed Gastric emptying • Anorexia
Macro	• Excess carb on PD • Excess lipids
Micro	• Restriction • Metabolism
Fluid	
Adherence and socioeconomic	

- Anorexia
- Altered taste sensation
- Nausea/vomiting
- Emotional distress
- Inter current illness
- Unpalatable prescribed diets
- Imposed dietary restriction
- Socioeconomic situation


Screen QOL goals collaboratively with health care team before NCP, if information available.
Nutrition Assessment & Reassessment
Nutrition Diagnosis
NCP
Nutrition Monitoring & Evaluation
Nutrition Intervention
Screen QOL goals collaboratively with health care team throughout NCP, as the clinical status changes.

Good history

Medical History	Medication	Dietary Interview Actual intake/RDA	Physical eating skills
Psychosocial status	normalized protein catabolic rate (nPCR).	Abnormal labs	Specific signs of vitamin deficiency
Dry weight los	Decrease oral intake	Change in GIT function	Complication with recommendation

Nutritional Assessment

Dietary intake

3-day food record or three 24-h recalls dietary recalls

Height- or length-for-age percentile or standard deviation score (SDS)

Height or length velocity-for-age percentile or SDS

Estimated dry weight and weight-for-age percentile or SDS

Head circumference until age 3

Kidney Disease Outcomes Quality Initiative, 2009

Nutritional assessment techniques: practical and theoretical advantages and limitations for use

Assessment Tool	What is assessed?	Advantages	Limitations
Classic anthropometry (Wt, Ht, HC)	Total body mass, growth (Wt) Linear growth (L) Brain growth (HC)	Reference standards available for all ages and sex	Unreliable when oedema is present Special equipment necessary at the bed-side
Circumferences (MUAC, CC)	Body composition	• Indirect measure of somatic protein • Indication of fat mass • Reference standards available for all ages and sex	• Values may fall in the normal range in the presence of PEM. • Unreliable when oedema is present
Skin folds (TSF, BSF)	Body composition	Indication of fat mass Reference standards available for all ages and sex	Large intra- and inter-observer variability Unreliable when oedema is present

Mid arm circumference(MUAC)

Measures muscle mass & subcutaneous tissue in upper arm.

Method:- B/W elbow and shoulder by tape. Arm should hang limply by the side.

Shakir's tape is used.

Interpretation:-

>13.5cm (Green)- adequate

12.5-13.5cm (Yellow)- **Boderline**

<12.5cm (red)- Frankly malnourished

Monitoring

- Frequency of monitoring nutritional and growth parameters in all children with CKD stages 2 to5 Twice as frequently as they would be performed in a healthy child of the same age.
- Polyuria, evidence of growth delay, decreasing or low BMI, comorbidities influencing growth or nutrient intake, or recent acute changes in medical status or dietary intake may warrant more frequent evaluation.

- A baseline height-for-age and weight-for-height of <10th percentile suggest poor baseline nutritional status.
- Weight at the time of hospital admission should be documented, but a history of pre-illness weight should be obtained since the critically ill child may present with fluid overload and weight gain .
- Triceps skin-fold thickness and mid-arm circumference may be used in children when weight or age data are not reliable.

Challenges of CKD patient

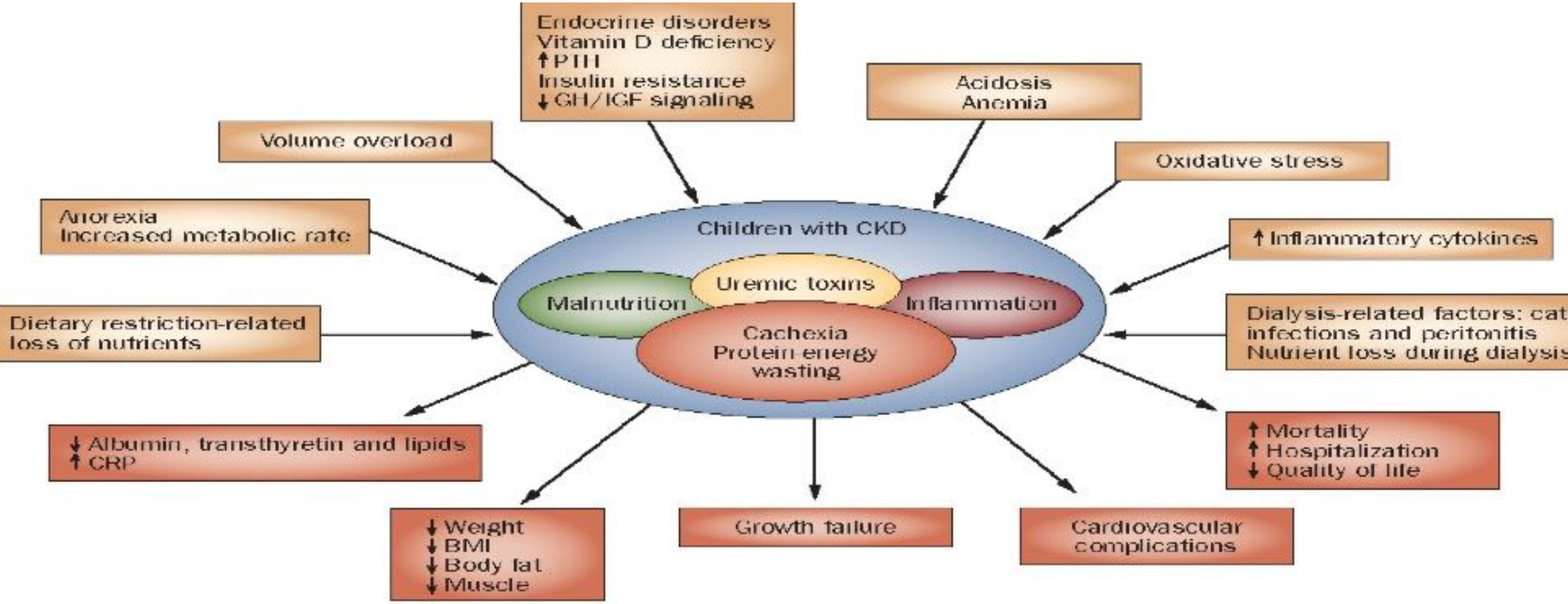
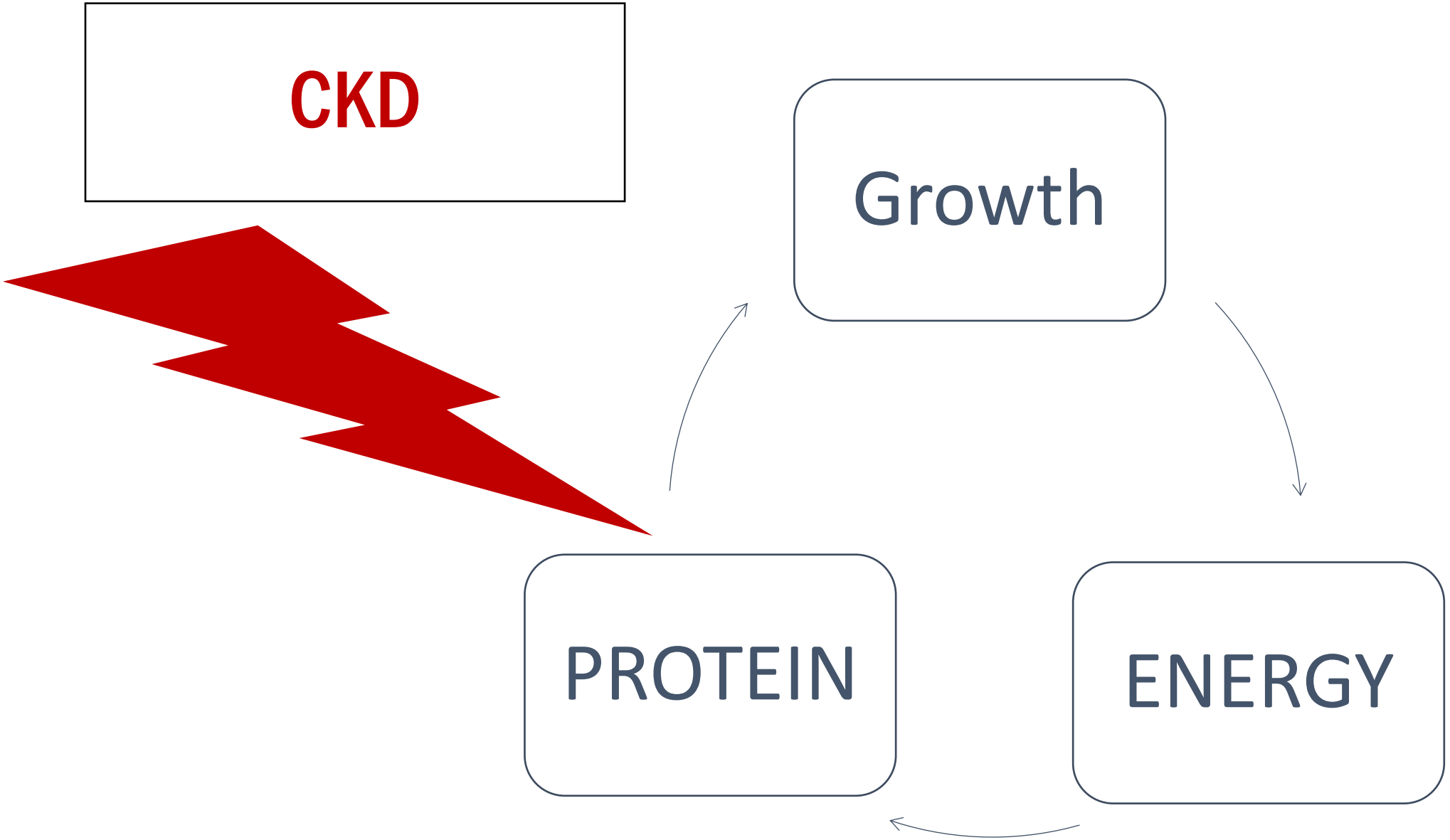
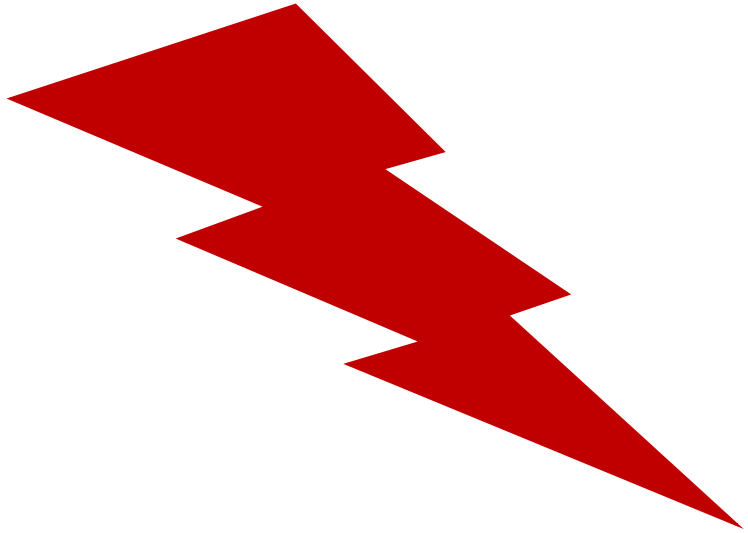
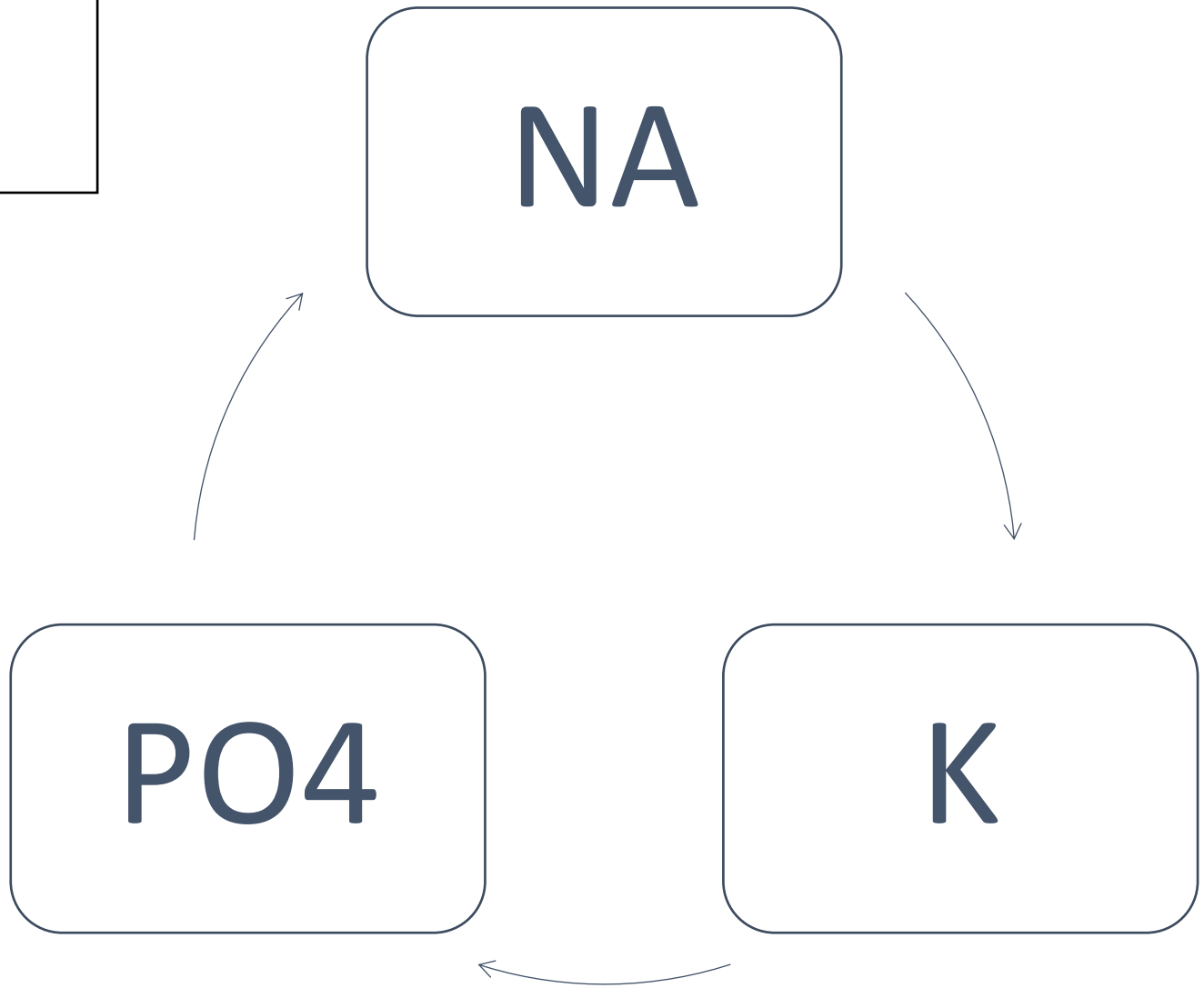


Figure 3 | Schematic representation of the causes and manifestations of PEW in children with CKD. Abbreviations: CKD


CKD
Growth
PROTEIN
ENERGY

CKD





Growth

- Identification and treatment of **existing nutritional deficiencies** and **metabolic abnormalities** should be **aggressively pursued** in children with CKD stages 2 to 5
- short stature(height SDS < 1.88 or height-for-age < 3rd percentile), and potential for linear growth
- Serum bicarbonate level should be corrected to at least the lower limit of normal (22 mmol/L) in children with CKD stages 2to5

Ahmed

- 3 year old CKD Stage 4
- Create 2.5 /Hyperphosphatemia /Hyperkalemia
- 24 hour recall 20% of needs
- picky eater sometimes anorexia likes dairy products yet restricted
- Inserted gastrostomy tube 2 months ago
- Weight 12 kg -1.7 sd
- Height 84 cm 3.26 sd
- Drugs calcium acetate ,iron, alphacalcidol, lactulose

Pediatric Nephrology (2020) 35:519–531
https://doi.org/10.1007/s00467-019-04426-0

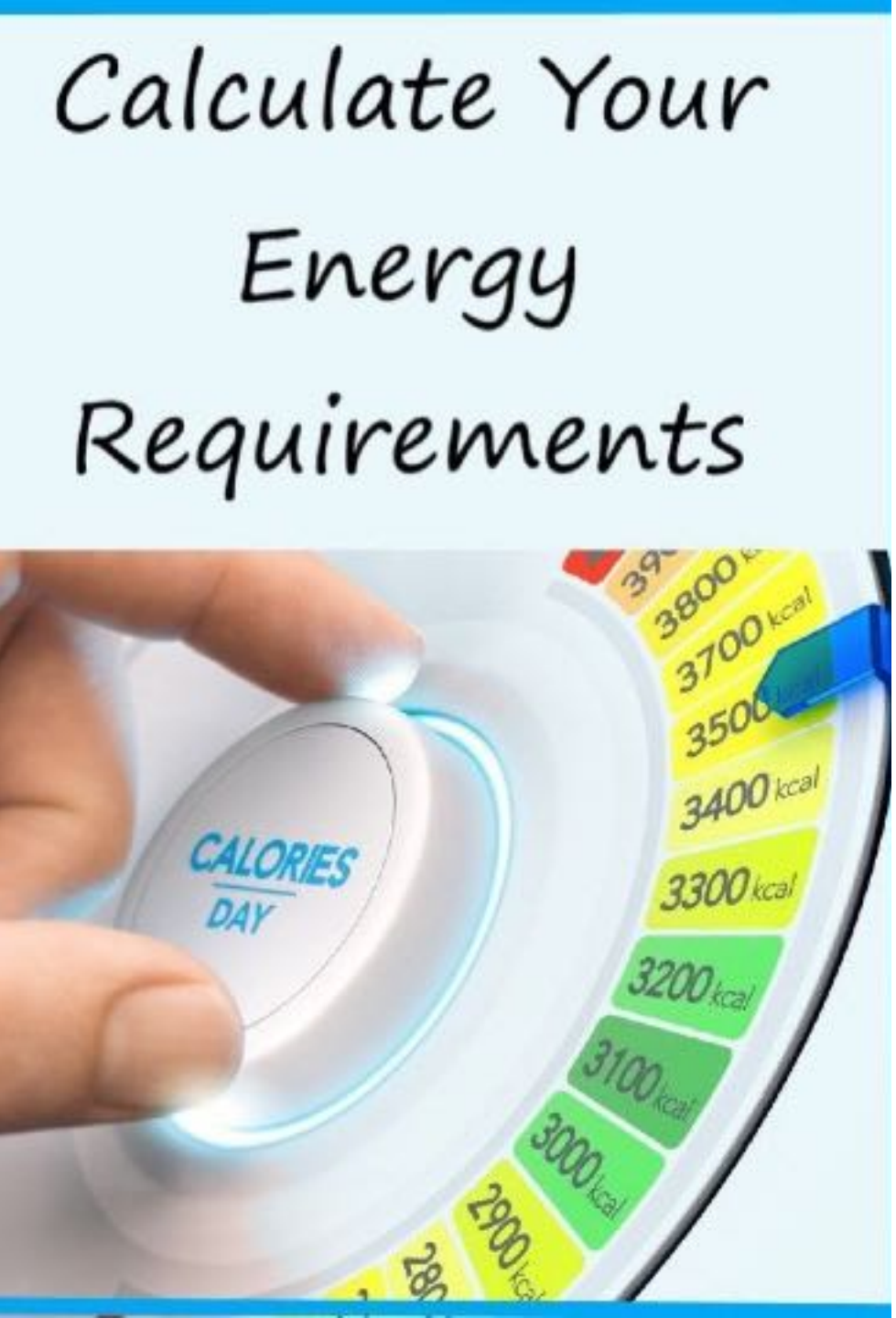
2020

GUIDELINES

Check for updates

Energy and protein requirements for children with CKD stages 2-5 and on dialysis–clinical practice recommendations from the Pediatric Renal Nutrition Taskforce

Vanessa Shaw[1,2] · Nonnie Polderman[3] · José Renken-Terhaerdt[4] · Fabio Paglialonga[5] · Michiel Oosterveld[6] · Jetta Tuokkola[7] · Caroline Anderson[8] · An Desloovere[9] · Laurence Greenbaum[10] · Dieter Haffner[11] · Christina Nelms[12] · Leila Qizalbash[13] · Johan Vande Walle[9] · Bradley Warady[14] · Rukshana Shroff[15,16] · Lesley Rees[15,16]



Energy Requirements CKD 2-5

Energy should be 100% of the EER for chronological age, individually adjusted for PAL and BMI)

A balance of calories from carbohydrate and unsaturated fats within the physiological ranges recommended when prescribing oral, enteral, or parenteral energy supplementation

Energy Requirements

Supplemental Nutritional Support

should be considered when the usual intake of a child with CKD stages 2 to 5 or 5D **fails to meet his or her energy requirements** and the child is not achieving expected rates of weight gain and/or growth for age.

Energy Requirements

Oral intake of an energy-dense diet and commercial nutritional supplements

should be considered the preferred route for supplemental nutritional support for children with CKD stages 2 to 5 and 5D.

- When energy requirements can not be met with oral supplementation, tube feeding should be considered.

Protein

- Essential for
- ❖ building muscles and repairing tissue
- ❖ fighting infection
- ❖Keeping fluid balance in the blood
- There are two kinds of proteins
  - Animal protein-meat, fish, poultry, eggs and dairy
  - Plant protein – breads, grains, vegetables, dried beans and peas and fruits
- 50 -70% should be of animal source
- A well balanced diet for kidney patients should include both kinds of proteins every day.

Protein portions are compared to a match box: one match box = 30 g and contains 7 g protein.

Protein

CKD STAGE 3 Maintain protein intake at 100% to 140% of the DRI

CKD STAGES 4 TO 5 100% to 120% of the DRI

In children with CKD stage 5d, maintain dietary protein intake at 100% of the DRI for ideal body weight plus an allowance for dialytic protein and amino acid losses.

The use of protein supplements to augment inadequate oral and/or enteral protein intake should be considered when children with ckd stages 2 to 5 and 5d are unable to meet their protein requirements through food and fluids alone.

ENERGY AND PROTEIN NEEDS

SDI for energy and protein: birth[a] to 18 years				
Month	SDI[b] energy (kcal/kg/day)	SDI protein (g/kg/day)	SDI protein (g/day)	
0	93–107	1.52–2.5	8–12	
1	93–120	1.52–1.8	8–12	
2	93–120	1.4–1.52	8–12	
3	82–98	1.4–1.52	8–12	
4	82–98	1.3–1.52	9–13	
5	72–82	1.3–1.52	9–13	
6–9	72–82	1.1–1.3	9–14	
10–11	72–82	1.1–1.3	9–15	
12	72–120	0.9–1.14	11–14	
Year	SDI energy (kcal/kg/day)		SDI protein (g/kg/day)	SDI protein (g/day)
–	Male	Female		
2	81–95[c]	79–92[c]	0.9–1.05	11–15
3	80–82	76–77	0.9–1.05	13–15
4–6	67–93	64–90	0.85–0.95	16–22
7–8	60–77	56–75	0.9–0.95	19–28
9–10	55–69	49–63	0.9–0.95	26–40
11–12	48–63	43–57	0.9–0.95	34–42
13–14	44–63	39–50	0.8–0.9	34–50
15–17	40–55	36–46	0.8–0.9	Male: 52–65 Female: 45–49

Dietary Protein And Progressive CKD

- Dietary protein intake to RDA / optimize nutritional status.
- No association between protein restriction and CKD progression in small studies
- Low protein diet leads to decrease in ions :-

✓Hyperkalemia

✓Metabolic acidosis

✓Hyperphosphatemia

✓Growth failure

Fats

- lipid profile usually characterized by

✓↑↑ TG

✓↑ cholesterol

✓↑ LDL

✓↓ HDL

✓Abnormal apolipoprotein

- If TG is increased

✓CHO ↓ 35-50% of total k.cal

✓Mostly complex CHO

✓PUFA : SFA > 2:1

- Patients considered at highest risk for cardiovascular disease
- Nutrition therapy for Dyslipidemia is based on pt's metabolic profile and individualized treatment goals
- Requirement of fat (30 % 40% total cal)

✓Minimize the ↑ in TG & Cholesterol

✓< 10% of calories ⟶ SFAc

✓ Ratio of USFAc to SFAc l fats = 2 : 1

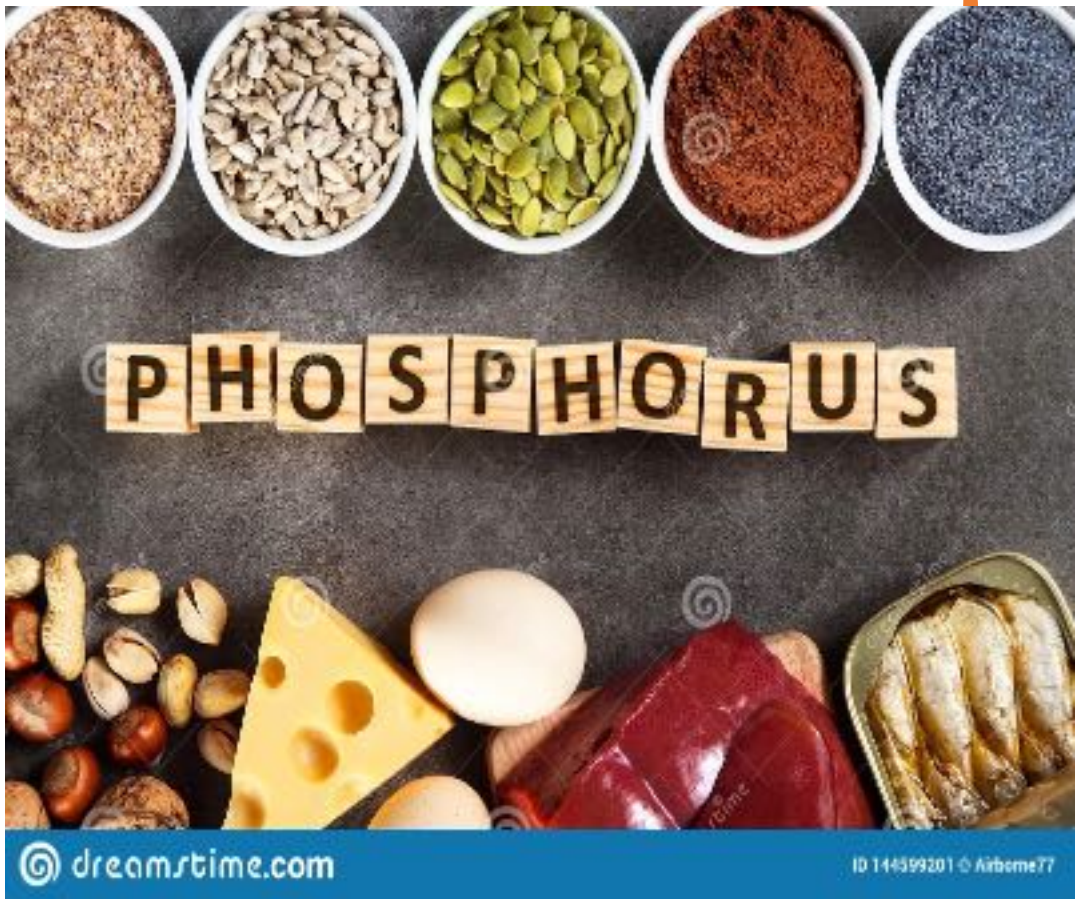
✓ 8% SFAc l :10 % PUSFAc : 12% , MUFAc

✓ 250–300 mg cholesterol/day

✓ Omega 3 fatty acid ↓ TG & Chol. as well as phospholipids may be tried

Tips to Implement AHA Pediatric Dietary Guidelines for Prevention or Treatment of Dyslipidemia and CVD in Prepubertal Children

Reduce added sugars, including sugar-sweetened drinks and juices.
Use canola, soybean, corn, or safflower oils, or other unsaturated oils, in place of solid fats during food preparation.
Use fresh vegetables and fruits, and serve at every meal; be careful with added sauces and sugars.
Introduce and regularly serve fish as an entrée.
Remove the skin from poultry before eating.
Use only lean cuts of meat and reduced-fat meat products.
Limit high-calorie sauces such as Alfredo, cream sauces, cheese sauces, and hollandaise.
Eat whole-grain breads and cereals rather than refined products.
Eat more legumes (beans) and tofu in place of meat for some entrees.
Read food labels—especially—for breads, breakfast cereals, and prepared foods—for content, and choose high-fiber, low salt/low-sugar alternatives.



Phosphorus Types

Organic phosphorus

40 – 60% absorbed

Phytates ↓ absorption

- Dairy products
- Meat, poultry, fish
- Soy (soy milk, tofu)
- Nuts and seeds
- Dried beans and peas
- Whole grains

Inorganic phosphorus

> 90% absorbed

absorbed easily

- Food additives
- Dietary supplements
- Calcium fortification

Phosphorus binders ineffective

READ THE INGREDENTS LABEL!!

Kalantar-Zadeh et al. Clin J Am Soc Nephrol 2010; 5(3):519-530

Hyperphosphatemia is a powerful independent predictor of mortality on dialysis therapy

Food	Portion size	P mg per portion (40-60% BA)
Human breast milk	100ml	15
Whey-dominant infant formula	100ml	32
Cow's milk	100ml	100
Yogurt	125ml	100-200
Fromage frais	60g	70
Ice cream	100g (2 scoops)	100
Cheese, hard (cheddar, edam, gouda, emmental)	1 thin slice (25g)	120-160
Cheese, soft (camembert, mozzarella)	30g	80
Processed cheese	25g	250
Cottage cheese	1 tablespoon (40g)	50-70
Egg (whole)	50g (1 egg)	100
Egg white	30g (from 1 egg)	4
Soya milk (not Ca-enriched)	100ml	10-50 / 50-100
Tofu (depending on production and cooking method)	2 tablespoons (50g)	50-135
Lamb, pork, beef, fish, chicken (fresh, raw)*	100	130-220
Beef burger / sausage / chicken nuggets	1 / 1 / 6	100
Processed cold meat (ham, chicken roll)	1 slice (25g)	80
Fish fillet (small) / fish fingers / prawns	50g / 2 / 10	100
Salmon	½ salmon steak	100
Scampi	3 pieces	100
Baked beans	2 tablespoons (80g)	70
Nuts	1 small bag (25g)	120

Know Your Normal Ranges

Table 25. Age-Specific Normal Ranges of Blood Ionized Calcium, Total Calcium and Phosphorus

Age	Ionized Calcium (mmol/L)	Calcium (mg/dL)	Phosphorus (mg/dL)
0-5 mo	1.22-1.40	8.7-11.3	5.2-8.4
6-12 mo	1.20-1.40	8.7-11.0	5.0-7.8
1-5 y	1.22-1.32	9.4-10.8	4.5-6.5
6-12 y	1.15-1.32	9.4-10.3	3.6-5.8
13-20 y	1.12-1.30	8.8-10.2	2.3-4.5

Adapted with permission[121]; Specker.[524]

Conversion factor for calcium and ionized calcium: mg/dL × 0.25 = mmol/L.

Conversion factor for phosphorus: mg/dL × 0.323 = mmol/L.

Know Your Requirements

SDI for age

Age (years)	SDI Ca (mg)	SDI P (mg)
0 - <4 months	220	120
4 - <12 months	330-540	275 - 420
1 - 3 years	450 - 700	250 - 500
4 - 10 years	700 - 1000	440 - 800
11 - 17 years	900 - 1300	640 - 1250

The adverse impact of hyperphosphatemia on **Cardiovascular, Bone, And Endocrine Function** in children with CKD mandates the preferential selection of protein sources that are relatively low in phosphorus.

The lowest amount of phosphorus in proportion to the quantity and quality of protein comes from animal-flesh proteins

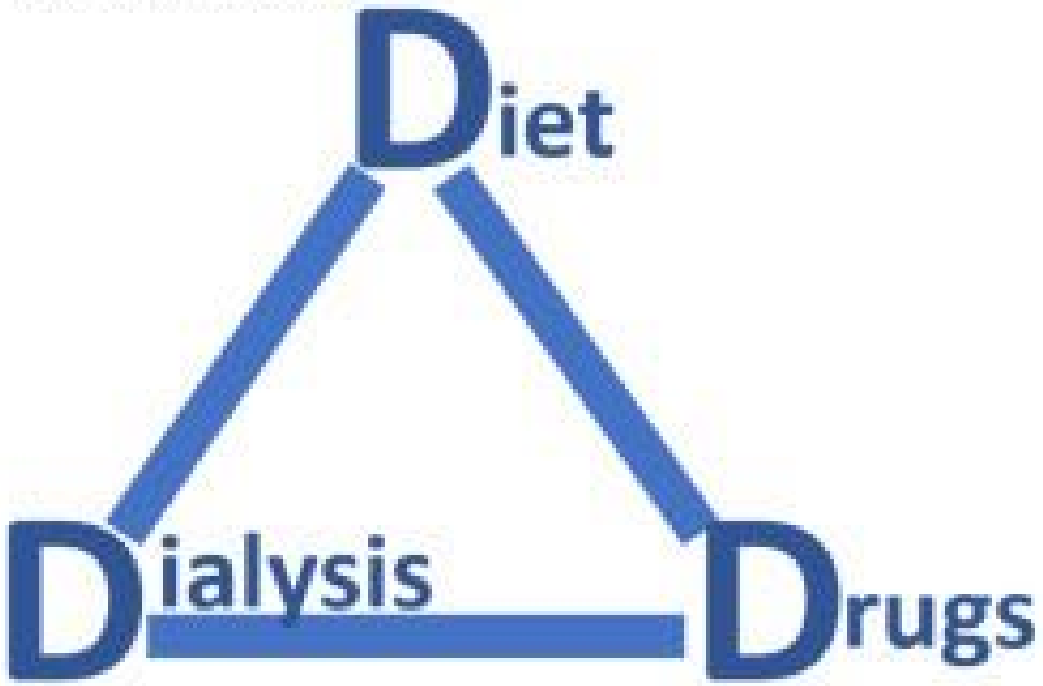
(average, 11 mg of phosphorus per 1 g of protein)

It appears mandatory to limit protein intake to the safe levels known to ensure adequate growth and nutrition in healthy children.

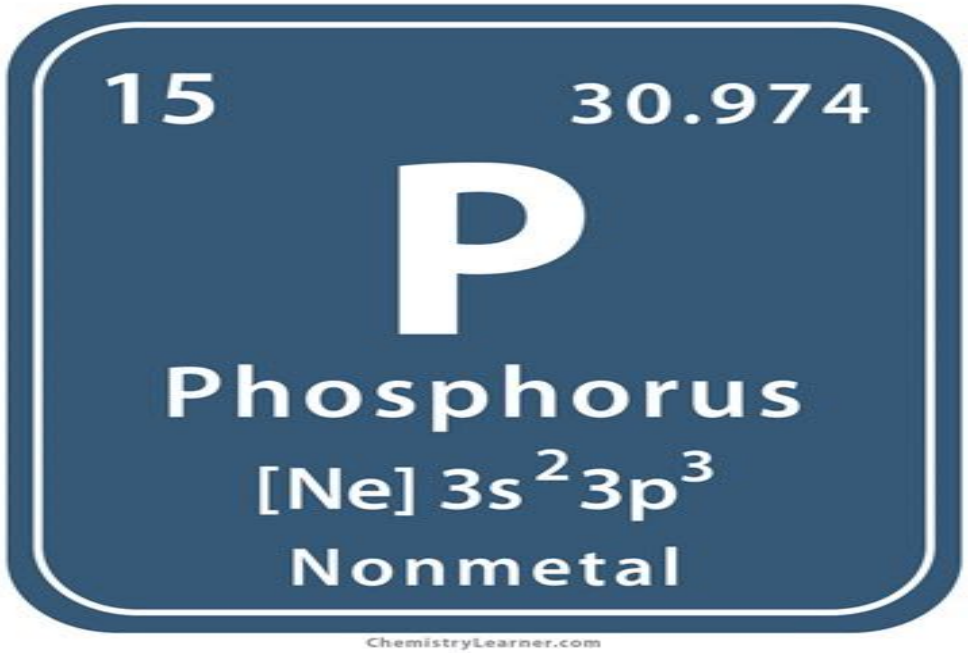
Conventional Approach

- Dietary intervention
- Phosphate binders
- Active/analog vitamin D
- Calcimimetics

All 3 key labs should be taken into account before making changes to the treatment plan, and first-line drug treatment may include a combination of phosphate binders, vitamin D, and calcimimetics.



2017 KDIGO Guide for Key CKD-MBD Labs	
Lab	**Goal**
Calcium	Avoid hypercalcemia
Phosphorus	Reduce toward the normal range
PTH	2x – 9x the upper limit of normal



Restrict to 100 % of DRII in children with CKD stages 3 to 5 and 5D

serum PTH concentration is above the target range for CKD stage and the serum phosphorus concentration is within the normal reference range for age.

Monitor

every 3 months in CKD stages 3 to 4

monthly in children with CKD stage 5 and 5D.

In all CKD stages, it is suggested to avoid serum phosphorus concentrations both above and below the normal reference range for age.

Step 1: Dietary assessment

Estimation of dietary Ca and P intake

Simple

- A diet history of a typical 24-hour period
- Identify the main dietary sources of Ca and P
- Recognise processed foods containing P additives

Detailed

- A 3-day prospective diet diary / food intake record
- Estimate intake of Ca and P if required by reference to food composition tables

An estimate of total Ca and P intakes should consider contributions from diet, infant and enteral formulas, nutritional supplements, dialysate and medications, including P-binders

Step 2: Ca and P requirements

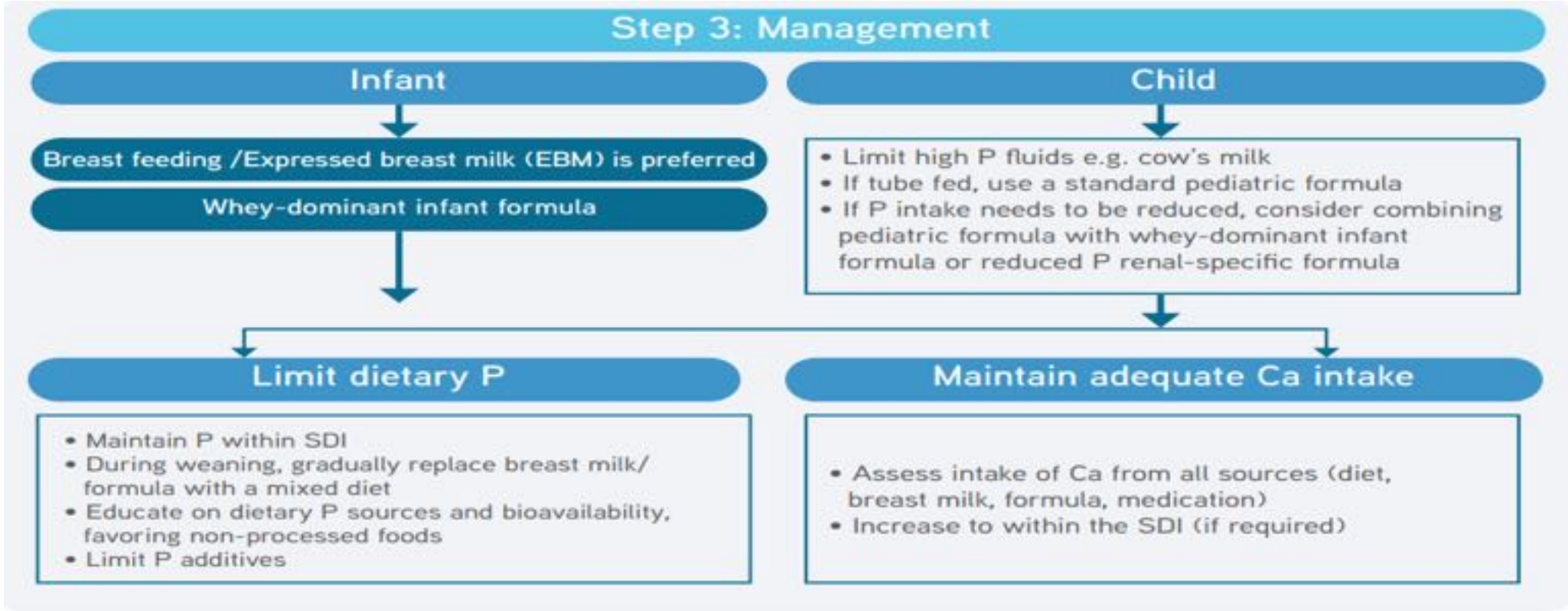
Compare intake to Suggested Dietary Intake (SDI) for age or height age (where height is <3rd centile)

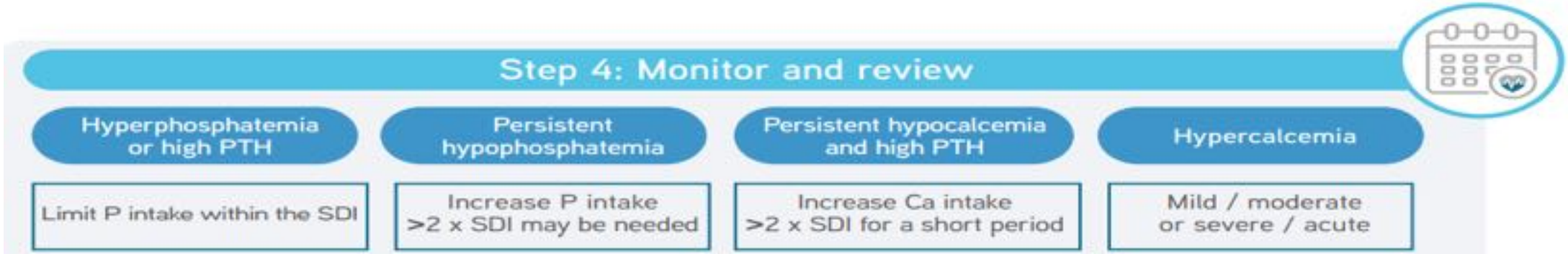
Routine management

- Ca intake within and up to 2 x upper SDI value
- P intake within SDI
- Limit P additives

Infants Mineral depleted bones

- May require >2 x upper SDI value for Ca
- P intake within SDI
- Limit P additives


Step 3: Management
Infant
Child
Breast feeding /Expressed breast milk (EBM) is preferred
Whey-dominant infant formula
• Limit high P fluids e.g. cow's milk
• If tube fed, use a standard pediatric formula
• If P intake needs to be reduced, consider combining pediatric formula with whey-dominant infant formula or reduced P renal-specific formula
Limit dietary P
Maintain adequate Ca intake
• Maintain P within SDI
• During weaning, gradually replace breast milk/ formula with a mixed diet
• Educate on dietary P sources and bioavailability, favoring non-processed foods
• Limit P additives
• Assess intake of Ca from all sources (diet, breast milk, formula, medication)
• Increase to within the SDI (if required)


Step 4: Monitor and review
Hyperphosphatemia or high PTH
Persistent hypophosphatemia
Persistent hypocalcemia and high PTH
Hypercalcemia
Limit P intake within the SDI
Increase P intake >2 x SDI may be needed
Increase Ca intake >2 x SDI for a short period
Mild / moderate or severe / acute

- Recommended Maximum Oral And Enteral Phosphorus Intake For Children With Ckd

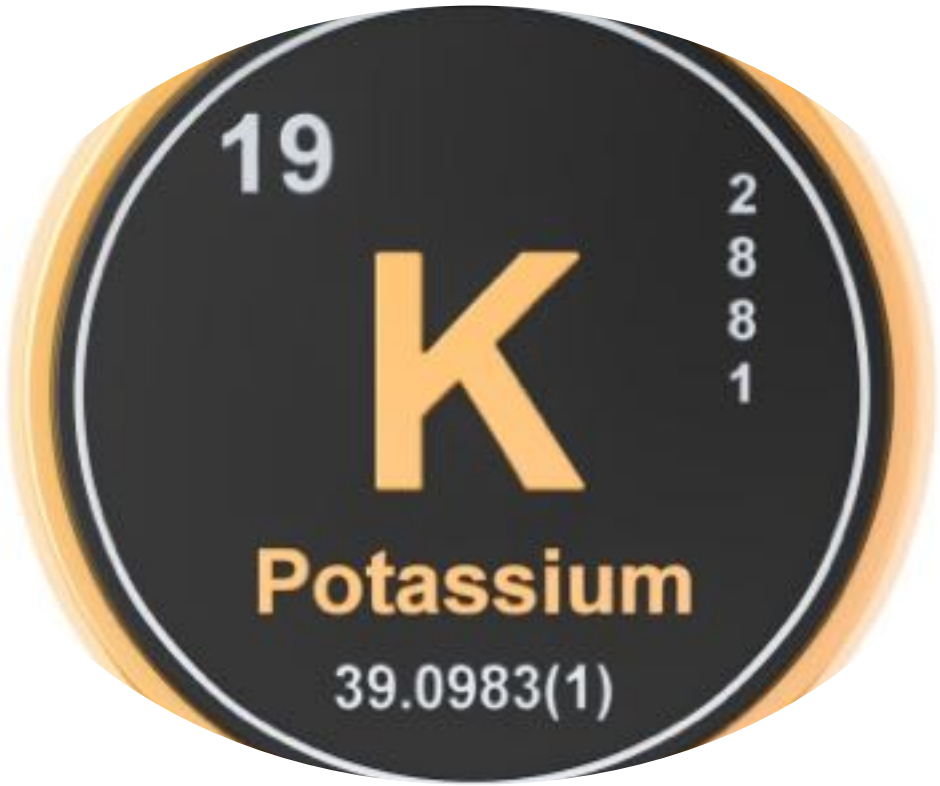
Age	DRI (mg/d)	Recommended Phosphorus Intake (mg/d)	
		High PTH and Normal Phosphorus*	High PTH and High Phosphorus†
0-6 mo	100	≤100	≤80
7-12 mo	275	≤275	≤220
1-3 y	460	≤460	≤370
4-8 y	500	≤500	≤400
9-18 y	1,250	≤1,250	≤1,000

Target Range of Serum PTH by Stage of CKD

CKD Stage	GFR Range (mL/min/1.73m^2)	Target Serum PTH (pg/mL)
3	30-59	35-70
4	15-29	70-110
5, 5D	<15	200-300

Reprinted with permission.[121]

Potassium



Aim for plasma potassium 3.0 - 5.0mmol/l.

Foods commonly eaten which are rich sources of potassium clude

• Chips • Fruits and vegetable • Potato crisps • Chocolate • Fresh fruit juices

otassium intake **should be limited** for children with CKD stages to 5 and 5D who have or are at risk of hyperkalemia. (A)

- Orange
- Melon
- Banana
- Avocado
- Potato
- Tomato
- Mango
- Nuts

- **Fruits & Vegetables**
  - Low: 20-150 mg
  - Medium: 150-250 mg
  - High: 250-550 mg
- Portion size is essential
- Avoid Salt Substitutes
- Dairy
  - **1 cup** 380-400 mg
  - High phosphorus foods

- Apples
- Grapes
- Berries
- Pineapple
- Tangerine
- ~~Cabbage~~
- Green Beans
- Cauliflower
- Eggplant

Table 12: High K⁺ foods with alternative lower K⁺ foods*

High potassium (>117mg (3mmol) per portion) | Moderate potassium (39-117mg (1-3mmol) per portion) | Lower potassium (<39mg (1mmol) per portion)

Food	Portion size	Potassium (mg per portion)	Potassium (mg per 100g)
MILKS AND DAIRY PRODUCTS			
Almond drink*^	100ml	67	67
Rice drink*^	100ml	27	27
Soya milk, unsweetened^	100ml	74	74
Human breastmilk, mature^	100ml	58	58
Standard whey-dominant infant formula	100ml	70	70
Fromage frais, fruit flavor	60g (1 small pot)	86	143
Ice cream, vanilla, soft scoop**	60g (1 scoop)	98	163
Cow's milk, whole	100ml	157	157
Custard, canned**	100g (3 Tbsp)	129	129
Yogurt, whole milk, fruit	125g (1 small pot)	213	170
POTATOES			
Potatoes, new, boiled, with skin	60g (1 small egg-sized)	226	377
Potatoes, old, baked in jacket, flesh only, no skin	100g (1 small)	360	360
POTATOES			
Potatoes, new, boiled, with skin	60g (1 small egg-sized)	226	377
Potatoes, old, baked in jacket, flesh only, no skin	100g (1 small)	360	360
Potatoes, chips, cut fine, fast food**	75g (small portion)	408	544
Potatoes, old, mashed with butter	45g (1 Tbsp)	151	337
Potatoes, old, roast	60g (1 small egg-sized)	358	597
CEREAL (GRAIN) AND CEREAL PRODUCTS			
Bread, white	40g (1 thick slice)	54	134
Bread, brown	40g (1 thick slice)	86	216
Bread, whole meal^^	40g (1 thick slice)	101	253
Breakfast cereal, cornflakes, fortified	20g (3 Tbsp)	18	88
Breakfast cereal, Swiss style muesli or crunchy/ crispy style muesli, with nuts, unfortified	30g (2 Tbsp)	87	290
Breakfast cereal, porridge made with water, fortified	135g (3 Tbsp)	62	46
Breakfast cereal, porridge made with whole milk, fortified	135g (3 Tbsp)	268	199
Breakfast cereal, puffed wheat, honey coated, fortified	20g (3 Tbsp)	38	188
Breakfast cereal, wheat biscuits, fortified	20g (1 biscuit)	79	397
Breakfast cereal with chocolate	30g (2 Tbsp)	74	245
Breakfast cereal, wheat and multigrain, chocolate flavored, fortified	30g (2 Tbsp)	107	355

Tips To Reduce Potassium

For Potatoes, Sweet Potatoes, Carrots , Beets and Rutabagas:

- Peel and place the vegetable in cold water so they won't darken.
- Slice vegetable 1/8 inch thick.
- Rinse in warm water for a few seconds.
- Soak for a minimum of two hours in warm water. Use ten times the amount of water to the amount of vegetables. If soaking longer, change the water every four hours.
- Rinse under warm water again for a few seconds.
- Cook vegetable with five times the amount of water to the amount of vegetable.

Sodium (133-145 mEq/L)

excess
high blood pressure
fluid retention/swelling (edema)
lead to shortness of breath
Excessive thirst
CHF

Supplemental free water and sodium supplements should be considered for children with CKD stages 2 to 5 and 5D and polyuria to avoid chronic intravascular depletion and to promote optimal growth.

Sodium supplements should be considered for all infants with CKD stage 5D on PD therapy.

Restriction of sodium intake should be considered for children with CKD stages 2 to 5 and 5D who have **hypertension or prehypertension**

Sodium and fluids

Insensible Fluid Losses

Age Group	Fluid Loss
Preterm infants	40 mL/kg/d
Neonates	20-30 mL/kg/d
Children and adolescents	20 mL/kg/d or 400 mL/m^2

- Fluid intake should be restricted in children with CKD stages 3 to 5 and 5D who are oligoanuric to prevent the complications of fluid overload.
- Increase Kcal density up to 60 kcal/ml This done gradually 20 kcal/oz and increase 2-4 kcal/oz

- In children with CKD stages 2 to 5 and5D,it is suggested that the total oral and/or enteral calcium intake from nutritional sources and phosphate binders be in the range of 100% to 200% of the DRI for calcium for age.
- Intake of 100% of the DRI for calcium is a reasonable starting point for children with CKD.

- The safe UL of dietary calcium intake in healthy individuals older than 1 year is 2,500 mg/d.
- For adults and children 9 years and older , this is approximately 2 times the DRI.

Recommended Calcium Intake for Children with CKD Stages 2–5 and 5D

Age	DRI	Upper Limit (for Healthy Children)	Upper Limit for CKD Stages 2–5, 5D (Dietary + Phosphate Binders)
0–6 months	210	ND	≤420
7–12 months	270	ND	≤540
1–3 years	500	2500	≤1000
4–8 years	800	2500	≤1600
9–18 years	1300	2500	≤2500

ND, not determined.
Determined as 200% of the DRI, to a maximum of 2500 mg elemental calcium.

Recommended Supplementation for Vitamin D Deficiency/Insufficiency in Children with CKD

Serum 25(OH)D (ng/mL)	Definition	Ergocaliferol (Vitamin D_2) or Cholecalciferol (Vitamin D_3) Dosing	Duration (months)
<5	Severe vitamin D deficiency	8000 IU/d orally or enterally × 4 wk or (50,000 IU/wk × 4 wk); then 4000 IU/d or (50,000 IU twice per mo for 2 mo) × 2 mo	3
5–15	Mild vitamin D deficiency	4000 IU/d orally or enterally × 12 wk or (50,000 IU every other wk, for 12 wk)	3
16–30	Vitamin D insufficiency	2000 IU daily or (50,000 IU every 4 wk)	3

Nutrition Prescription in renal patient

- **In infancy, feeds should be of breast milk or a whey-based infant formula with a low renal solute load if needed.**
- Weaning solids should be introduced at appropriate time
- In children, high energy foods and drinks are recommended as part of a controlled intake, with nutritional supplements or nutritionally complete feeds introduced if necessary.
- We suggest that the concentration of feeds and addition of dietary supplements are prescribed in a gradual manner in order to maximize acceptance and tolerance.
- We suggest prompt intervention once deterioration in weight centile is noted.
- All dietary prescriptions should be individualized.

Adequate energy ,tailored protein ,Low solute load (LOW K,PO4,CL,Na)

- Renastart can be used in Acute Kidney Injury (AKI) and Chronic Kidney Disease (CKD).
- Alone or in combination with breast milk ,enteral formula
- This means that energy and protein intakes can be met whilst managing serum potassium and phosphate levels.

Nutrition Prescription

- Overall aim/goal:
  To improve nutritional status and increase weight and height whilst managing serum urea, potassium and phosphate levels

- A low potassium feed was trialled for a short period of approximately 7 days as a means of reducing dietary potassium intake due to hyperkalaemia. Bloods were checked regularly throughout this period and the feed was tolerated well.

A modular feed was then devised consisting of a low potassium feed, a high energy paediatric feed. This feed was devised to ensure nutritional requirements were met whilst still continuing to manage serum potassium and phosphate levels. This feed provided 1.81 kcal/ml and 3.1 g protein / 100 ml

Check serum potassium, phosphate, calcium, bicarbonate, sodium in infants

Table 2. Nutritional comparison of Renastart with enteral products suitable for infants and children.

	Protein g	Energy kcal	Na mg/mmol	K mg/mmol	P mg/mmol	Ca mg/mmol	Vit A IU/µg
In infancy Per 100 ml							
Infant formula (standard dilution[1])	1.2	67	21 / 0.9	85 / 2.1	24 / 0.8	43 / 1.1	193 / 58
Mature breast milk[2]	1.3	69	15 / 0.6	58 / 1.5	15 / 0.5	34 / 0.9	205 / 62
Renastart 13.5% dilution[3]	1.0	67	32 / 1.4	15 / 0.4	13 / 0.4	16 / 0.4	60 / 18
Renastart 15% dilution[3]	1.1	75	36 / 1.5	17 / 0.4	14 / 0.4	18 / 0.5	67 / 20
Renastart 20% dilution[3]	1.5	100	48 / 2.1	22 / 0.6	19 / 0.6	24 / 0.6	87 / 26
For over 1 year of age Per 100 ml							
Renastart 20% dilution[3]	1.5	100	48 / 2.1	22 / 0.6	19 / 0.6	24 / 0.6	87 / 26
Renastart 30% Dilution[3]	2.3	150	72 / 3.1	33 / 0.8	28 / 0.9	36 / 0.9	130 / 39
Renastart 40% Dilution[3]	3.0	200	96 / 4.1	44 / 1.1	38 / 1.2	48 / 1.2	173 / 52
Standard paediatric enteral feed[4]	2.8	100	60 / 2.6	110 / 2.8	53 / 1.7	56 / 1.4	150 / 45
Whole cow's milk[2]	3.4	63	42 / 1.8	157 / 3.9	96 / 3.1	120 / 3.0	128 / 38

Nutrition Prescription

- Energy =RDA X Expected dry weight/ Actual dry weight=90x15/12=1350 kcal
- Protein =12 gm
- Challenges poor appetite ,minimal oral,intake ,restrictions due to hyperkalemia and hyperphosphatemia

Half needs could be given via high calorie low solute load formula
3 cups 200 ml standard dilution

Check serum potassium, phosphate, calcium, bicarbonate, sodium in infants

Calculate volume and concentration needed as part of total diet

In infants under 1 year of age:

Renastart is typically used in dilutions providing between:

- 0.74kcal/ml (15g of Renastart made up to 100ml with water, 15% dilution)

  and

- 1kcal/ml (21g or 3 scoops of **Renastart** added to 90ml water, 20% dilution).

Where feed volume intake is restricted, the higher concentration of **Renastart**, at 1kcal/ml, may be appropriate to ensure nutritional requirements are met[1-4].

In children over 1 year of age:

Renastart is typically used in dilutions providing between:

- 1kcal/ml (21g or 3 scoops of **Renastart** added to 90ml water, 20% dilution)

  and

- 2kcal/ml (40g of Renastart made up to 100 ml with water, 40% dilution).

Where feed volume intake is restricted, the higher concentration of **Renastart**, at 2kcal/ml, may be appropriate to ensure nutritional requirements are met[1-4].

MyPlate for Healthy Eating with Chronic Kidney Disease

Low Sodium • Low Potassium • Low Phosphorus

Grains

- ½ cup white rice or pasta
- 1 cup puffed rice cereal
- 1 small dinner roll
- 1 English Muffin
- 1 slice of white or sourdough bread
- 1 small flour tortilla
- ½ cup grits or farina

Fruits

1 serving = ½ cup/ 1 fruit

- Apple
- Strawberries
- Blueberries
- Cherries
- Cranberries
- Grapes
- ½ Grapefruit
- Lemon
- Lime
- Mandarin Oranges
- Canned peaches
- Pineapple (2 rings)
- Plum
- Tangerine

Dairy

- ½ cup milk (fluid) or yogurt
- 1 tbsp cream cheese
- ½ cup ice cream (fluid)

limit these foods: ↑phosphorus

Non-Dairy Substitutes

- ½ cup liquid creamer (fluid)
- ½ cup whipped topping
- Non dairy frozen dessert (fluid)

Fats

1 serving = 1 tsp to 1 tbsp

- Oil
- Butter
- Mayo
- Dressing

Vegetables

1 serving = ½ cup cooked

- Green beans
- Cabbage
- Corn
- Cucumber
- Lettuce
- Onions
- Green peas
- Zucchini
- Radishes

Snack Items

- 6 unsalted crackers
- 2 Shortbread cookies
- ½ cup unsalted pretzels
- 10 vanilla wafers
- 2 graham crackers

Protein

1 serving = ~3 oz.

- Low salt turkey or low salt ham lunch meat.
- Lean beef
- Chicken
- Fish & low salt tuna
- Turkey
- Tofu
- Egg substitute or 1 egg & egg whites

Dialysis Tips

- ✓ Monitor your fluids.
- ✓ Choose low salt food varieties.
- ✓ Take phosphate binders with meals & other medications daily.

Ask your Renal Dietitian for advice on your daily goal from each food group to meet your individual needs!

RENAL EXCHANGES FOR MEAL PLANNING

Food Groups	Kcal	CHO g.	PRO g.	FAT g.	Na mg.	K+ mg.	PO4 mg.
Milk (½ c.)	85	6	4	5	80	185	110
Meat	65	0	7	4	25	100	65
Starch	80	15	2	1	80	35	35
Vegetable	25	5	1	0	15	150	20
Fruit	60	15	0.5	0	5	150	15
Fat (1TB.)	100	0	0	11	150	0	5
Calorie Boosters	60	15	0	0	15	20	5
Beverages: Coffee (1c.) tea (1 bag) wine (4 oz.) beer (12 oz.)	0	0	0	0	0	100	0

Another case

Anthropometrics

Weight: 2.8 kg, 50-75%ile
Length: 46 cm, ~50%ile
Weight/length: ~90%ile

Biochemical

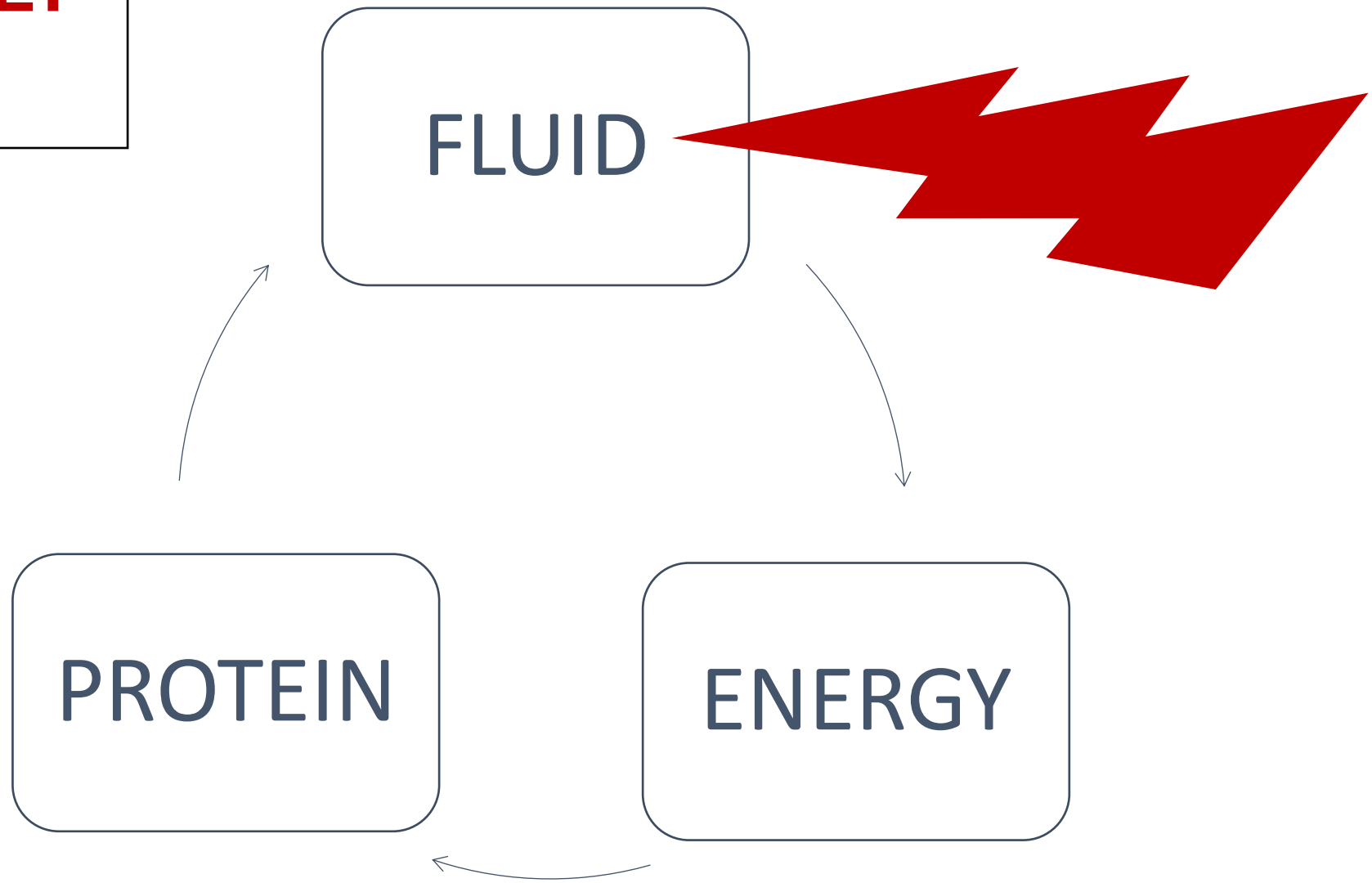
BUN 24 (H), Cr 1.8 (H), K+ 5.6, PO4 5.9, Ca++ 9.5, albumin 3.2, CO2 18 (L)

Medications

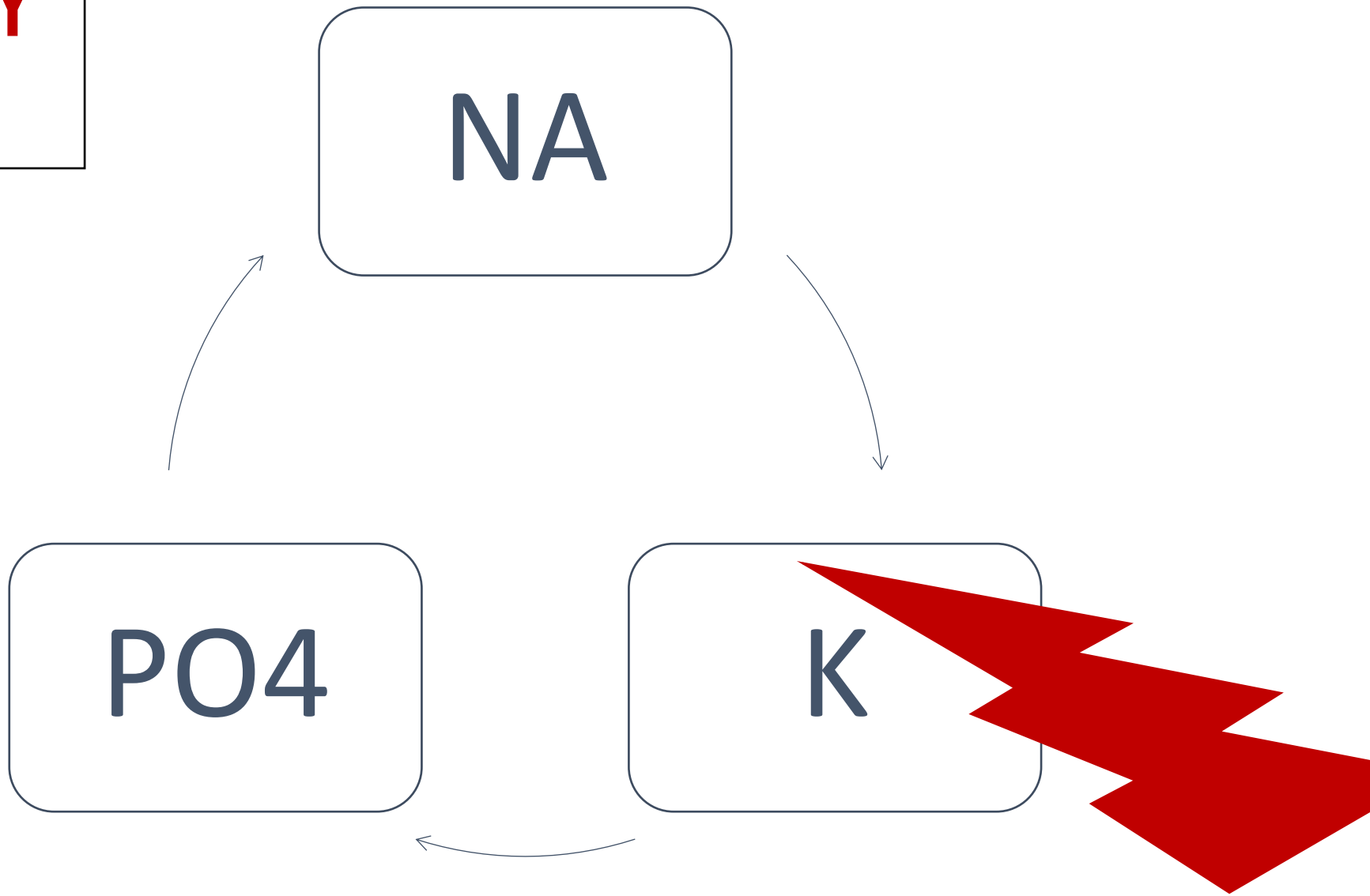
sodium bicarbonate

Background
2 months old,renal dysplasis
,AKI, planned for PD

ACUTE KIDNEY INJURY



ACUTE KIDNEY ENETGY



In children with AKI, Physiological macronutrient requirements are age-dependent, reflecting the developmental dynamic of growth and metabolism.

critically ill children, like adults, should receive 100-130% of the basal energy expenditure , which can be estimated with acceptable precision and accuracy by the Caldwell-Kenndy equation

Protein intake 2.4 , 1.9 and 1.3 g/Kg/d in children aged < 1 - 1,13 , and > 13 years , respectively

Although not validated by outcome studies, these figures provide an orientation for the macronutrient supply typically achieved in and tolerated by children with AKI receiving RT

Nutrition Prescription

- Energy =REE=330
- Protein =5 gm
- Challenges FLUID RESTRICTION, HYPERKALEMIA, HYPERPHOSATEMIMIA,acidosis
- Start 25% low renal solute load formula

25ml Renastart to 75ml exp breast milk /
Calculate volume needs
Start low solute load formula for 24 hours
Concentrate formula as needed

Check serum potassium, phosphate, calcium, bicarbonate, sodium in infants

Renastart is typically used in conjunction with breast milk, standard infant formula, standard paediatric enteral feeds and / or mixed diet. However, it can be used alone initially (in the short term) to decrease a very high serum potassium level.

Is the patient's serum potassium level between 3.5-5.0 mmol/L?

Yes: The patient's serum potassium level is within the normal reference range. Therefore, you should use breast milk, standard infant formula, standard paediatric enteral feeds and / or oral diet rather than a low potassium feed such as Renastart.

Is the patient's serum potassium level between >5.0-6.0 mmol/L?

Yes: Change to a ¼ Renastart and ¾ breast milk / standard infant formula / standard paediatric enteral feed ratio.

Example: 25ml Renastart to 75ml breast milk / standard formula / standard paediatric enteral feed - extrapolate to individual volume needs.

Check serum potassium, phosphate, calcium, bicarbonate, sodium and urea levels within 24 hours of the feed change.

Is the serum potassium level now within normal range? (Feed change should result in a serum potassium level of between 3.5-5.0 mmol/L).

Is the patient's serum potassium level ≥ 6.0 mmol/L?

Yes: Ensure all non-dietary causes of hyperkalaemia are corrected with medical management as appropriate.

If deemed appropriate, consider using Renastart for all feeds **(short term only)** and closely monitor serum potassium, phosphate, calcium, bicarbonate, sodium and urea levels within a few hours of starting the feed. Please note that Renastart, when used alone, can result in hypokalaemia.

Is the serum potassium level now within normal range? (Feed change should result in a serum potassium level of between 3.5-5.0 mmol/L).

Is the serum potassium level now within normal range? (Feed change should result in a serum potassium level of between 3.5-5.0 mmol/L).

No: If the serum potassium level continues to be >5.0 mmol/L increase the ratio of Renastart in the feed to ½ and have ½ breast milk / standard infant formula / standard paediatric enteral feed.

If the serum potassium level has dropped to 3.5 mmol/L or less, re-introduce breast milk, standard infant formula or a standard paediatric enteral feed according to serum potassium levels.

Monitor serum potassium levels within 24 hours

If the serum potassium level continues to be >5.0 mmol/L increase the ratio of Renastart in the feed to ¾ and have ¼ breast milk / standard infant formula / standard paediatric enteral feed.

Is the serum potassium level now within normal range? (Feed change should result in a serum potassium level of 3.5-5.0 mmol/L).

Yes: Continue to monitor - however if the serum potassium levels drop to 3.5 mmol/L or less, reduce the proportion of Renastart in the feed.

Yes: Continue current dietary management and continue to monitor serum potassium, phosphate, calcium, bicarbonate, sodium and urea levels at least every 24 hours.

The proportion of Renastart in the total feed can be adjusted depending upon the serum potassium levels.

Is the serum potassium level now within normal range? (Feed change should result in a serum potassium level of between 3.5-5.0 mmol/L).

Yes: According to serum potassium levels, gradually reintroduce breast milk, standard infant formula or a standard paediatric enteral feed.

Continue to monitor serum potassium, phosphate, calcium, bicarbonate, sodium and urea levels at least every 24 hours and adjust proportion of Renastart accordingly.

No: Continue current dietary management and monitor serum potassium, phosphate, calcium, bicarbonate, sodium and urea levels every few hours. If serum potassium level is not decreasing to within the normal range re-check that all non-dietary causes of hyperkalaemia have been corrected and seek further appropriate medical management.

No: Ensure all non-dietary causes of hyperkalaemia are corrected. If deemed appropriate, consider using Renastart for all feeds **(short term only)** and closely monitor serum potassium, phosphate, calcium, bicarbonate, sodium and urea levels. Renastart, when used alone, can result in hypokalaemia. Breast milk, standard infant formula or a standard paediatric enteral feed should be gradually reintroduced according to serum potassium levels.

Take home messages

- Poor nutrition is common in CKD & AKI patients and has adverse risk factor
- Nutritional counselling –part of approach to CKD and dialysis patients.
- Routine nutritional screening & assessment should be done for CKD and dialysis patients.
- Qualified renal dietitian must be included in the staff of every dialysis unit.
- Personalized nutritional plan – worked out for every patient

Multidisciplinary team

- Nephrologist
- Nutritionist
- Psychotherapist
- Nurse
- Social worker
- caregiver


Thank you
dryasmingamal@yahoo.com