KDOQI CLINICAL PRACTICE GUIDELINE FOR NUTRITION IN CHRONIC KIDNEY DISEASE: 2020 UPDATE

Overview/Introduction

WHAT IS NEW AND WHAT DO WE CHANGE?

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Objectives

- Explain the guideline development process and the benefits of multidisciplinary collaboration between the National Kidney Foundation and the Academy of Nutrition and Dietetics to produce global evidence-based nutrition guidelines for patients with chronic kidney disease.
- Recognized the differences between the KDOQI Nutrition 2000 and KDOQI Nutrition 2020 recommendations.

Outline

- Introduction
- Guideline Development Process
- What is Different in the Updated Guideline?
- Conclusion

Introduction

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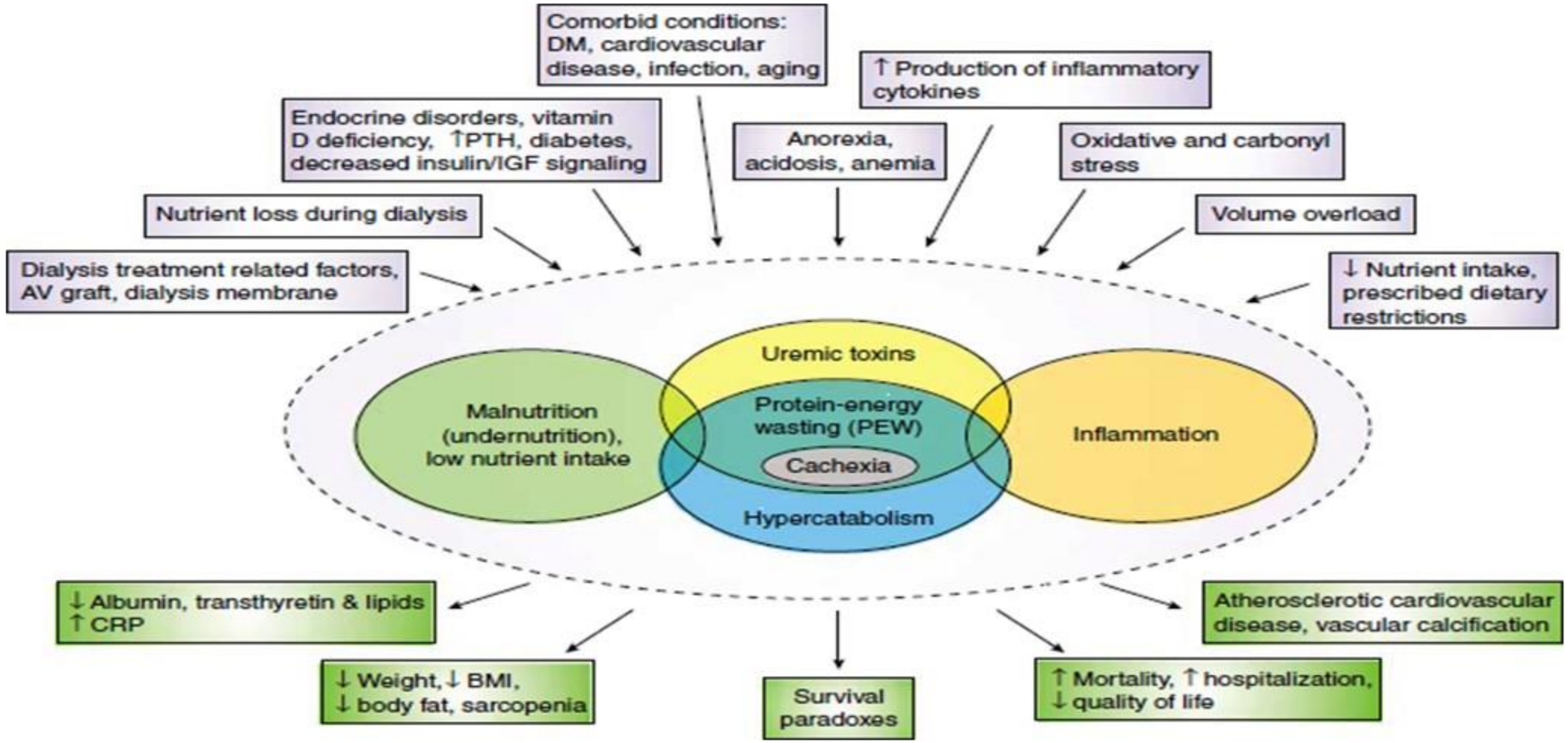
Nutrition in CKD is …..Complex



Clinical Practice Guidelines for Nutrition in Chronic Renal Failure

- ✓Published in 2000
- ✓**Content and relevance changed**
- ✓**Not graded**

International representation of Work Group Members

NKF-KDOQI and Academy-EAL collaboration on CKD Guideline Work Group Members

Co-Chairs: T. Alp Ikizler, MD & Lillian Cuppari, PhD

Macronutrients

Laura Byham-Gray, PhD, RDN, FNKF (Chair)
Denis Fouque, MD, PhD
Winnie Chan, PhD, RD
Jerrilynn Burrowes, PhD, RD, CDN
Daniel Teta, MD, PhD

Micronutrients

Angela Wang, MD, PhD (Chair)
Jordi Fuchs, DSc, APN,NP-C,RD
Joel Kopple, MD
Sana Ghaddar, PhD, RDN
Alp Ikizler, MD

Electrolytes & other nutrients

Juan Jesus Carrero, PhD Pharm, PhD Med, MBA (Chair)
Katrina Campbell, PhD, RD
George Kaysen, MD, PhD
Allon Friedman, MD, FASN
Lilian Cuppari, PhD

Guideline Development Process

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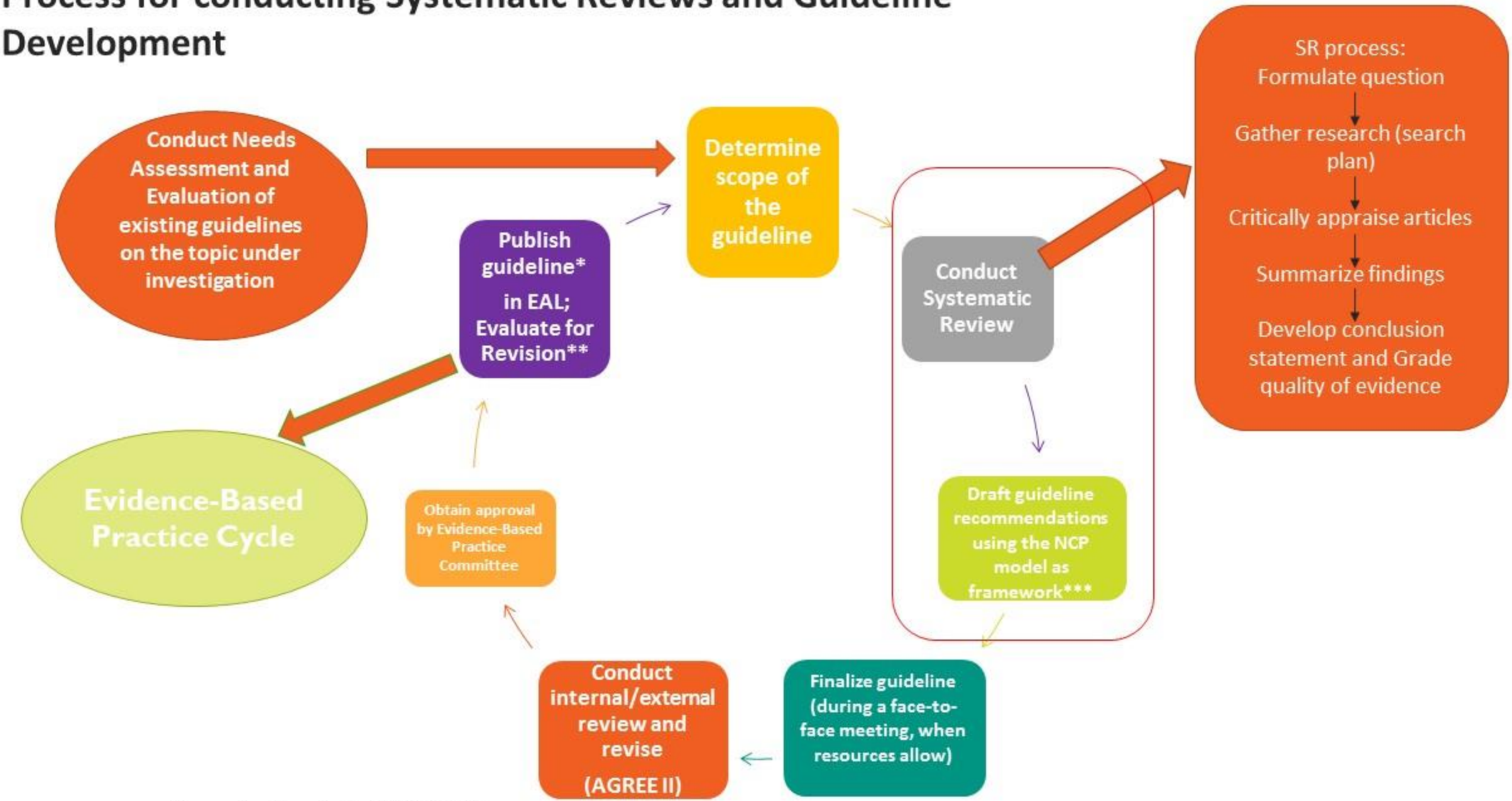
Process for conducting Systematic Reviews and Guideline Development



Papoutsakis et al, JAND 2016

Steps in conducing a Systematic Review

Grade ≠GRADE

Question Development : PICO format

- Questions are organized by subtopics and within subtopics by Nutrition care process:
  - Macronutrients
  - Micronutrients
  - Electrolytes
- Overview of questions within subtopics are focused on:
  - Assessment questions
  - Intervention questions
  - Monitoring questions

Outcomes of Interest (not all are presented here)

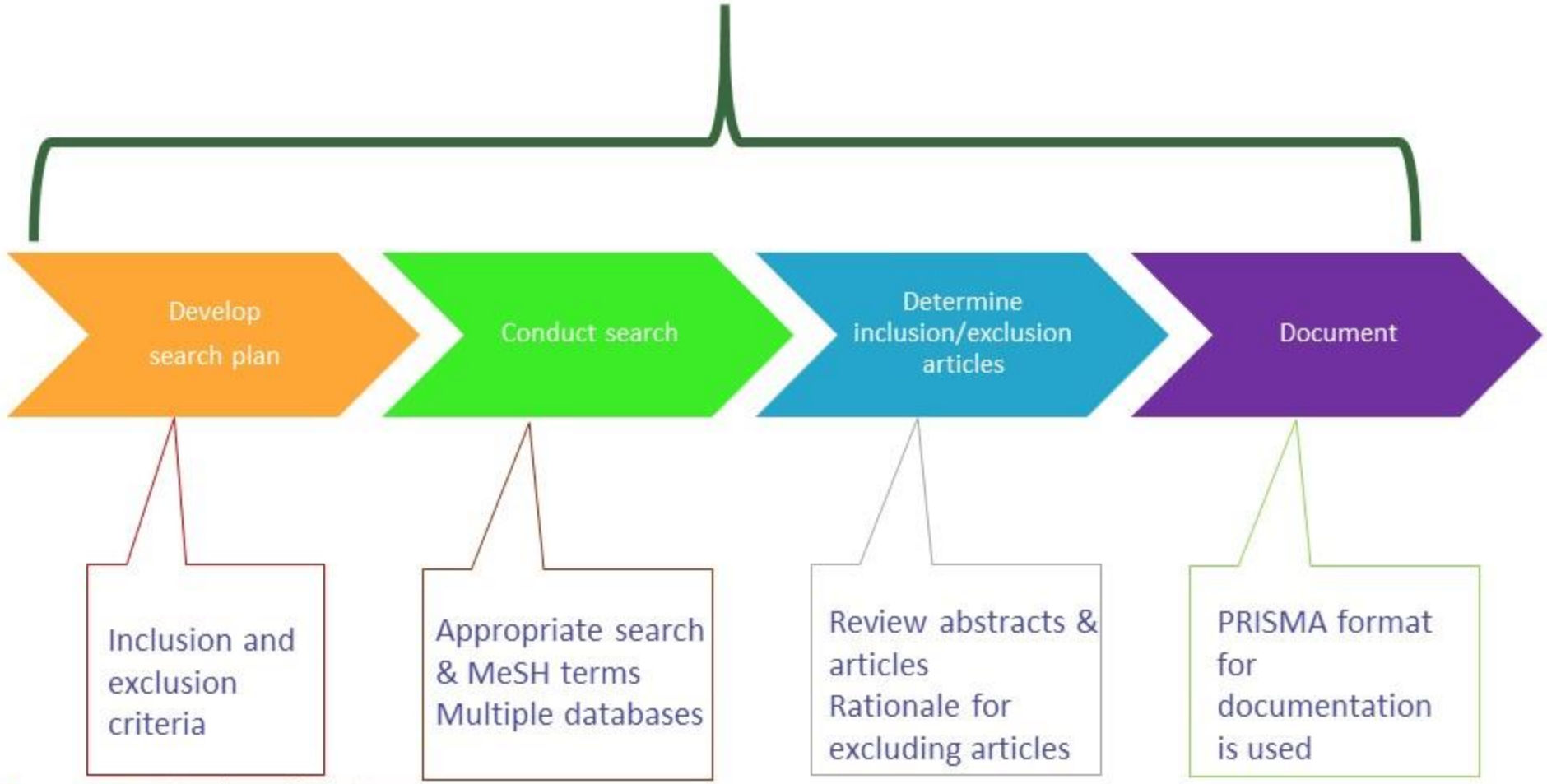
Major categories of outcomes:

- Hard outcomes:
  - Mortality, RRT, QoL etc hospitalizations
- Nutritional status outcomes:
  - SGA, PWS, Protein markers etc
- Dietary intake outcomes:
  - FFQ, 24-hr recall, diet history etc
- Inflammation outcomes
  - CRP, adipokines, cytokines etc
- Anthropometrics
  - Body wt, BMI, WC, Skinfold thickness etc

- Major categories of outcomes:
  - Electrolyte biomarkers:
    - Na, Mg, K, Phos, Ca, Acid load etc
  - Micronutrient biomarkers:
    - Serum or urinary excretion for all included micronutrient
  - CKD progression:
    - eGFR, s. creatinine, etc
  - Comorbidity outcomes
    - Lipid profile, BP etc

Gather and Classify the Research : Search Process – A Rigorous Process

Workgroup Oversees/Decision Makers



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Search Plan

- Brief Inclusion criteria

  CKD all stages

  Searched databases from 1985 to 2016

  Limited to controlled trials for intervention questions

    At least n=6 in each arm

  Limited to controlled trials + observational studies for assessment questions

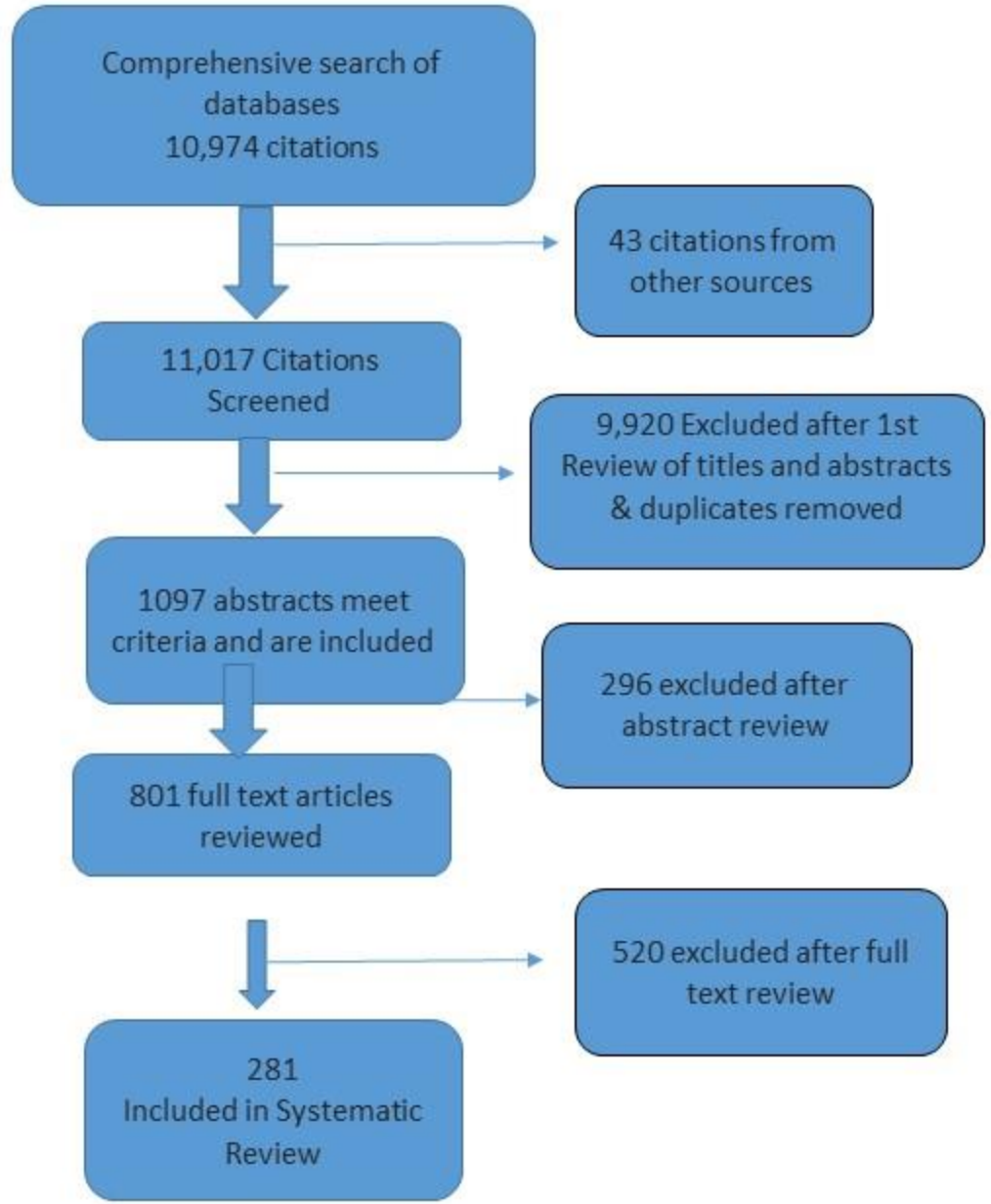
  Assessment questions: studies needed to have a comparative tool/method

Searched multiple databases

Hand searched published Systematic reviews and other guidelines

Search Results

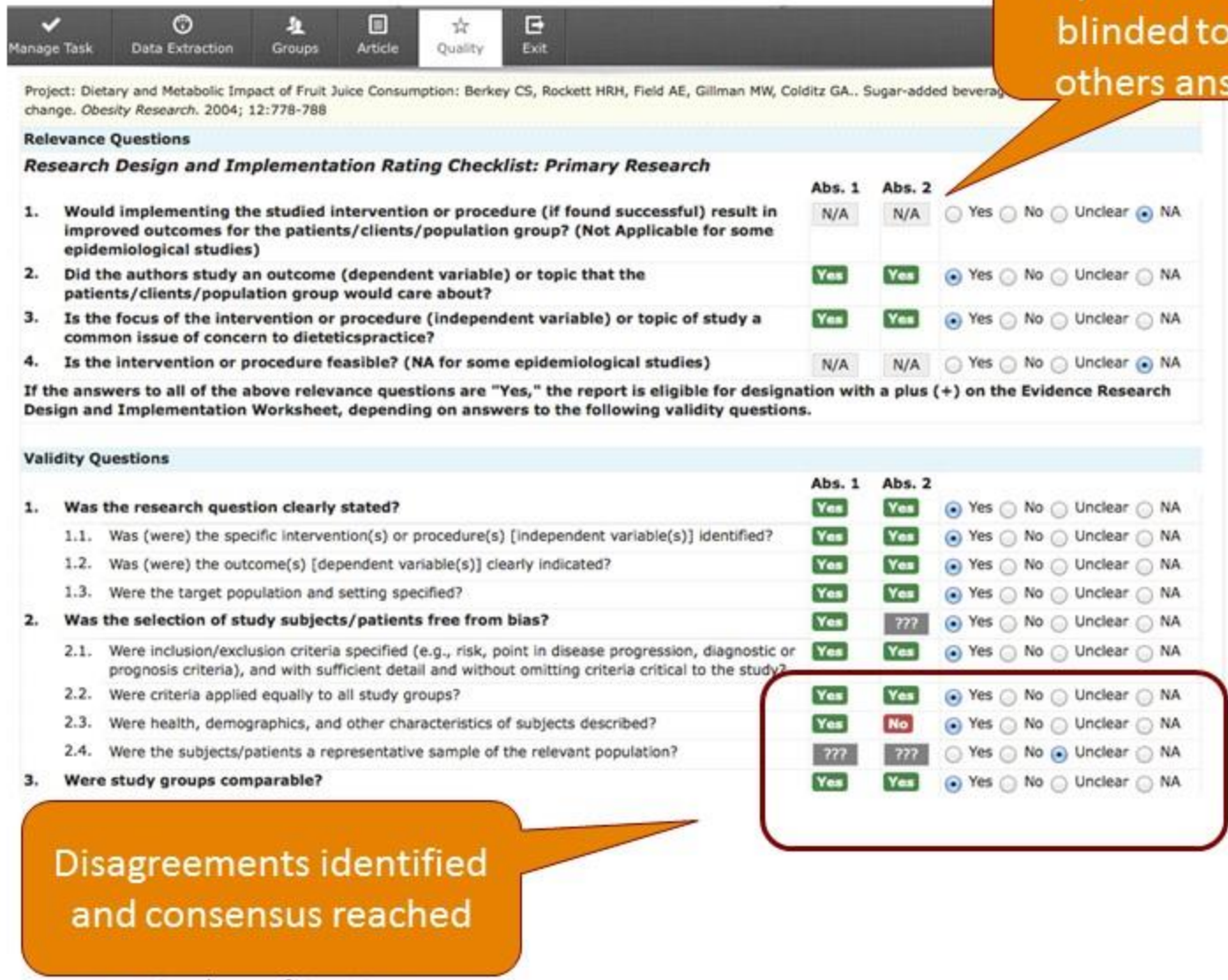
Search for literature related to **Intervention questions** completed



Critically Appraise Each Article and data extraction: Risk of bias

- Academy of Nutrition and Dietetics Quality criteria checklist (QCC) was used
  - QCC is based on ROB domains of Cochrane
- Data extraction
  - Data extraction guide based on questions that needed to be answered was developed
  - Used Academy's online data extraction tool (DET)
- Read and analyze articles
  - Complete worksheets (DET for each article)
  - Complete quality checklists

Double Blind Bias Assessment



Assessment of bias by two analysts, blinded to each others answers.

Disagreements identified and consensus reached

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Summarize the Evidence: Aggregating the data

Evidence Statements and Study Details for each Outcome

Conclusion Statement

CKD progression (Predictor: dietary phosphate restriction): In pre-dialysis patients, dietary protein and phosphate restriction did not slow the rate of CKD progression (e.g., mean rate of fall of creatinine clearance, plasma creatinine, or distribution of those who improved or worsened) in one study.

Proposed Grade for Quality of Evidence: B

Evidence Summary

In pre-dialysis patients, the effects of dietary phosphate restriction and phosphorus/phosphate biomarkers on CKD progression were mixed and also evidence was limited (three studies). Compared to control, dietary protein and phosphate restriction and phosphate restriction only did not show any significant difference in mean rate of fall of creatinine clearance, plasma creatinine, or distribution of those who improved, worsened or were unchanged (Williams et al, 1991; dietary protein and phosphate restriction: protein: 0.6 g/kg/day, phosphate: 800 mg, energy intake ≥ 30 kcal/kg/day; dietary phosphate restriction only: protein: 0.8 g/kg/day, phosphate: 800 mg, energy intake ≥ 30 kcal/kg/day (plus orally administered phosphate binder)). Greater 24-hr urinary phosphate excretion was not associated with ESRD (i.e., progressed to ESRD) in Selamet et al, 2016, while greater urinary phosphorus excretion per creatinine clearance was associated with greater CKD progression (e.g., progressed to ESRD or 50% reduction of eGFR) in Kawasaki et al, 2015. In adults with chronic kidney disease, one positive-quality randomized controlled trial (Williams et al, 1991), one positive-quality prospective cohort study (Selamet et al, 2016), and one positive-quality retrospective cohort study examined the effects of dietary phosphate intake or phosphorus/phosphate biomarkers on CKD progression.

Phos = phosphorus

Results from SR = Evidence Summary Table

Evidence Summary Table: Phosphorus/Phosphate

Study	Sample Characteristics	Intervention/ Duration	Outcomes		Results and conclusions	Study Quality
Author, Year, Country, Study Design			**IG (n/N)(%)**	**CG (n/N)(%)**		
			Dietary intake			
Williams 1991 Europe (UK) Randomized Controlled Trial PMID 1801057 [Protein; Phosphate]	N = 95 Dialysis: patient not on dialysis Stage not reported (chronic renal failure) P status: not reported	Dietary protein and phosphate restriction: Protein: 0.6 g/kg/day, phosphate: 800 mg, energy intake ≥ 30 kcal/kg/day Dietary phosphate restriction only: Protein: 0.8 g/kg/day, phosphate: 800 mg, energy intake ≥ 30 kcal/kg/day (plus orally administered phosphate binder) Control: Protein: 0.8 g/kg/day, energy intake ≥ 30	Dietary protein and phosphate restriction: 33/95 (34.7%) Dietary phosphate restriction only: 30/95 (31.9%) *Dietary phosphate intake (baseline vs follow-up) (mg/day):* Dietary protein and phosphate restriction: 1420±78 vs 815±43 Dietary phosphate restriction only: 1343±77 vs 1000±47	Control: 32/95 (33.7%) Control: 1408±68 vs 1315±57	Phosphate intake decreased in both dietary protein and phosphate restriction and dietary phosphate restriction only groups but p-values were not reported.	+

GRADE Table: Phosphorus/Phosphate

Quality assessment							№ of patients		Effect		Quality	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	phosphorus/phosphate intervention	control	Relative (95% CI)	Absolute (95% CI)		
Dietary phosphorus/phosphate intake (Williams et al, 1991; Lou et al, 2012) (follow up: range 6 months to 19 months)												
2	randomised trials	not serious	not serious	not serious	serious [a]	none	104	103	-	MD **2.916 mg/day lower** (5.647 lower to 0.185 lower)	⊕⊕⊕◯ MODERATE	NOT IMPORTANT
Phosphorus/phosphate biomarkers (Williams et al, 1991; Martinez et al, 1997; Sigrist et al, 2012; Lou et al, 2012; Sullivan 2009) (follow up: range 10 days to 19 months)												
5	randomised trials [b]	serious [c]	not serious	not serious	not serious	none	287	243	-	Not estimable – inconsistent data representation/format. Dietary phosphorus/phosphate restriction decreased serum phosphorus and urinary phosphorus /phosphate excretion.	⊕⊕⊕◯ MODERATE	NOT IMPORTANT

SR to Practice Recommendations

Systematic Reviews

EBP Nutrition Guidelines

GRADE Methodology

Assigns separate grades for:

1) ***Evidence Quality***
2) ***Strength of Recommendation***

Quality of evidence	High	A		**Strength of recom-mendation**	Level 1
	Moderate	B			
	Low	C			Level 2
	Very low	D			

Guideline work group decision

Limitations and issues

Literature search was intended to be comprehensive, however, they were not exhaustive.

Were not able to contact authors for incomplete data. Data presented in published original research was used in data analysis.

Eligible studies published after search dates or in congress proceedings have not been included.

Inconsistent reporting of clinical outcomes of interest resulted in evidence synthesis difficulty. (standardization of outcomes is needed in this field)

Low quality evidence in certain areas required substantial use of WG expertise to draft a recommendation

Issues with nutrition studies: baseline exposure, nutrient status, confounding variables…

What is Different in the Updated Guideline?

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What is different in the Updated Guidelines?

KDOQI 2000 guideline

- Population: Maintenance Dialysis; Adv. CRF without Dialysis
- Literature search dates: 1966 – 1997

Update KDOQI-Academy of Nutrition and Dietetics guideline

- Population: Adults with Chronic Kidney Disease: Stages 1-5, including dialysis and post-kidney transplant
- Literature search dates: 1985 - 2016

What is different in the Updated Guidelines?

- Topic covered
  - Evaluation of Protein Energy Nutritional Status
  - Management of Acid-Base Status and Protein and Energy Status
  - Nutritional Counseling and Follow-up
- Topics covered
  - More Comprehensively covered and additional "NEW" statements; more evidence-based statements
- Carnitine
- Carnitine- literature in this area was NOT explored in this update
- Micronutrients- NEW
- Electrolytes-NEW

Assessment Recommendations

- Composite Nutrition Assessment Scores
- Dietary Intake Assessment
- Resting Energy Expenditure
- Laboratory Values
- Anthropometric and other measures to assess body composition
- Technical Devices to assess body composition

Assessment Recommendations

KDOQI (2000)	KDOQI-AND (2019)	Changes
No specific screening recommendation	**Routine Nutrition Screening** ✓ In adults with **CKD 3-5D and post-transplant**, it is reasonable to consider routine nutrition **screening at least biannually** with the intent of identifying those at risk of protein-energy wasting (OPINION).	New
N/A	**Nutrition Screening Tools** ✓ In adults with **CKD 3-5D and post-transplant**, there is limited evidence to suggest the use of one tool over others for identifying those at risk of protein-energy wasting (2D).	New

Assessment Recommendations - Body Composition

KDOQI (2000)	KDOQI-AND (2019)	Changes
Dual Energy X-Ray Absorptiometry (DXA) • DXA is a valid and clinically useful technique for assessing protein energy nutritional status. (Evidence and Opinion) • • Accurate data on body composition are helpful to assess long-term adequacy of protein-energy nutritional status. • • Whole body DXA provides an accurate method to assess body composition which is less influenced by the abnormalities in hydration status common in maintenance dialysis patients.	**DEXA for Body Composition Assessment** • In adults with **CKD 1-5D and post-transplant**, , it is reasonable to use dual-energy x-ray absorptiometry (DEXA) when feasible as it remains the **gold standard** for measuring body composition despite being influenced by volume status (OPINION).	Updated: Included non-ESRD

Assessment Recommendations - Serum Biomarkers

KDOQI (2000)	KDOQI-AND (2019)	Changes
Serum Albumin • Serum albumin is a valid and clinically useful measure of protein-energy nutritional status in maintenance dialysis (MD) patients.*(Evidence)*	**Serum Albumin Levels** • In adults with **CKD on maintenance dialysis**, low serum albumin may be used as a predictor of **hospitalization and mortality** (1A).	Updated
Serum Prealbumin **Serum Cholesterol** **Serum Creatinine** • Serum Prealbumin, Cholesterol and Creatinine are valid and clinically useful markers of protein-energy nutritional status in maintenance hemodialysis patients. *(Evidence and Opinion)*	**No specific statement** **Covered under Rationale Section**	Updated

Assessment Recommendations - SGA/MIS

KDOQI (2000)	KDOQI-AND (2019)	Changes
Subjective Global Nutritional Assessment (SGA) • SGA is a valid and clinically useful measure of protein-energy nutritional status in maintenance dialysis patients. *(Evidence)*	**7-point Subjective Global Assessment (SGA)** • In adults with **CKD 5D**, we recommend the use of the 7-point Subjective Global Assessment as **a valid and reliable tool** for assessing nutritional status (1B).	Updated
N/A	**Malnutrition Inflammation Score (MIS)** • In adults with **CKD on MHD and post-transplant**, Malnutrition Inflammation Score may be used to assess nutritional status (2C).	New

Assessment Recommendations - Nutrient Intake

KDOQI (2000)	KDOQI-AND (2019)	Changes
Dietary Interviews and Diaries • Dietary interviews and/or diaries are valid and clinically useful for measuring dietary protein and dietary energy intake in maintenance dialysis patients. *(Evidence and Opinion)*	**Considerations when Assessing Dietary Intake** • In adults with **CKD 3-5D and post-transplant**, it is reasonable to **assess factors beyond dietary intake** (e.g. medication use, knowledge, beliefs, attitudes, behavior and access to food, depression, cognitive function etc.) to effectively plan nutrition interventions. (OPINION). **3 Day Food Records to Assess Dietary Intake** • In adults with **CKD 3-5D**, we suggest the use of a **3-day food record**, conducted during both dialysis and non-dialysis treatment days (when applicable), as a preferred method to assess dietary intake (2C).	Updated; New Statements

Intervention Recommendations

- Medical Nutrition Therapy (MNT)
-Protein requirements
- Energy requirements
-Protein-Energy supplements (oral, dialysate, IDPN, enteral & parenteral)
- omega-3 supplements
-Dietary Patterns
-Micronutrients
-Electrolytes

Intervention Recommendations - MNT

KDOQI (2000)	KDOQI-AND (2019)	Changes
Intensive Nutritional Counseling With Maintenance Dialysis (MD) • Every MD patient should receive intensive nutritional counseling based on an individualized plan of care developed before or at the time of commencement of MD therapy. (Opinion). • A plan of care for nutritional management should be developed before or during the early phase of MD care and modified frequently based on the patient's medical and social conditions. • The plan of care should be updated at least every 3 to 4 months. • Nutrition counseling should be intensive initially and provided thereafter every 1 or 2 months and more frequently if inadequate nutrient intake or malnutrition is present or if adverse events or illnesses occur that may cause deterioration in nutritional status.	**Medical Nutrition Therapy** • *In adults with **CKD 1-5D**, we recommend that a registered dietitian nutritionist (RDN) or an international equivalent, in close collaboration with a physician or other provider (nurse practitioner or physician assistant), provide medical nutrition therapy (MNT).* Goals are to optimize nutritional status, and to minimize risks imposed by co-morbidities and alterations in metabolism on the progression of kidney disease (1C) and on adverse clinical outcomes (OPINION). • MNT should be tailored to the individuals' needs, nutritional status, and comorbid conditions (OPINION).	Updated

Intervention Recommendations - DPI_CKD

KDOQI (2000)	KDOQI-AND (2019)	Changes

Dietary Protein Intake for Nondialyzed Patients
• For individuals with chronic renal failure (GFR _25 mL/min) who are not undergoing maintenance dialysis, the institution of a planned low-protein diet providing 0.60 g protein/kg/d should be considered.
• For individuals who will not accept such a diet or who are unable to maintain adequate DEI with such a diet, an intake of up to 0.75 g protein/kg/d may be prescribed. (Evidence and Opinion)
	Protein Restriction, Non-Dialysis
	• In adults with **CKD 3-5** who are metabolically stable, we recommend protein restriction with or without keto acid analogs, depending on keto analog availability, patient preference and clinician judgement, to reduce risk for **ESRD/death (1A) and improve QoL (2C).**
	  • a low protein diet providing **0.55 to 0.60** g dietary protein per kg body weight per day , OR
	  • a very-low protein diet providing **0.28 to 0.43** g dietary protein/kg body weight/day **with additional keto acid analogs to meet protein requirements** (0.55 to 0.60 g/kg body weight/day)
		Updated
		Strong
		Imperative

Intervention Recommendations - DPI_CKD

KDOQI (2000)	KDOQI-AND (2019)	Changes
Dietary Protein Intake for Nondialyzed Patients - DM **N/A**	**Protein Restriction, Non-Dialysis - DM** • In the adult with **CKD 3-5 (non-dialyzed) and who have diabetes**, it is reasonable to prescribe a dietary protein intake of **0.6 – 0.8 g /kg** body weight per day to maintain a stable nutritional status and optimize glycemic control. **(Opinion)**	NEW Opinion
Protein Intake During Acute Illness • The optimum protein intake for a maintenance dialysis patient who is acutely ill is at least 1.2 to 1.3 g/kg/d. (Opinion) • • Acutely ill maintenance hemodialysis patients should receive at least 1.2 g protein/kg/d. • • Acutely ill chronic peritoneal dialysis patients should receive at least 1.3 g protein/kg/d.	• **N/A**	

Intervention Recommendations - DPI_MHD

KDOQI (2000)	KDOQI-AND (2019)	Changes
Dietary Protein Intake (DPI) in Maintenance Hemodialysis (MHD) • The recommended DPI for clinically stable MHD patients is 1.2 g/kg body weight/d. (Evidence and Opinion) • At least 50% of the dietary protein should be of high biological value.	**Dietary Protein Intake, Maintenance Hemodialysis and Peritoneal Dialysis** • In adult with **CKD on MHD (1C) and PD (OPINION) who are metabolically stable**, we recommend prescribing a dietary protein intake of **1.0 -1.2** g /kg ideal body weight per day to maintain a stable nutritional status.	Updated
Dietary Protein Intake, MHD/PD; DM **N/A**	**Dietary Protein Intake, MHD/PD; DM** • In adults with **CKD on MHD and PD and who have diabetes**, it is reasonable to prescribe a dietary protein intake of **1.0 -1.2 g /kg body weight per day** to maintain a stable nutritional status. For patients at risk of hyper and/or hypoglycemia, higher levels of dietary protein intake may need to be considered to maintain glycemic control (OPINION).	New

Intervention Recommendations - DPI_PD

KDOQI (2000)	KDOQI-AND (2019)	Changes
Dietary Protein Intake (DPI) for Chronic Peritoneal Dialysis (CPD) • The recommended DPI for clinically stable CPD patients is **1.2 to 1.3 g/kg body weight/d.** (Evidence) • • Dietary protein intake should be no less than 1.2 g/kg/d. • • Unless a patient has demonstrated adequate protein nutritional status on a 1.2 g protein/kg/d diet, 1.3 g protein/kg/d should be prescribed. • • At least 50% of the dietary protein should be of high biological value.	**Dietary Protein Intake, Maintenance Hemodialysis and Peritoneal Dialysis** • In adult with **CKD on MHD (1C) and PD (OPINION) who are metabolically stable**, we recommend prescribing a dietary protein intake of **1.0 -1.2 g /kg ideal body weight per day** to maintain a stable nutritional status.	Updated

Intervention Recommendations – Protein type

KDOQI (2000)	KDOQI-AND (2019)	Changes
N/A	**Protein Type** In adults with **CKD 1-5D (1B) and post-transplant (OPINION)**, there is **insufficient evidence** to make conclusions about the effects of protein type (plant vs animal) on nutritional status, calcium or phosphorus levels, or the blood lipid profile.	New Opinion

Intervention Recommendations - Energy_CKD/MD

KDOQI (2000)	KDOQI-AND (2019)	Changes
Dietary Energy Intake (DEI) for Nondialyzed and Maintenance Dialysis Patients • The recommended DEI for individuals with chronic renal failure (CRF; GFR _25 mL/min) who are not undergoing maintenance dialysis is **35 kcal/kg/d** for those who are younger than 60 years old and 30 to 35 kcal/kg/d for individuals who are 60 years of age or older. (Evidence and Opinion) • The recommended daily energy intake for maintenance hemodialysis or chronic peritoneal dialysis patients is **35 kcal/kg** body weight/d for those who are less than 60 years of age and 30 to 35 kcal/kg body weight/d for individuals 60 years or older. (Evidence and Opinion)	**Energy, CKD 1-5D and post-Tx** • In adults with **CKD 1-5D (1C) and post-transplant (OPINION) who are metabolically stable**, we recommend prescribing an energy intake of **25-35 kcal/kg ideal body weight per day** based on age, gender, level of physical activity, body composition, weight status goals, CKD stage, and concurrent illness or presence of inflammation to maintain normal nutritional status.	Updated Opinion

Dietary Protein and Energy Intake Implementation considerations

- Increase the training and number of specialized renal dietitians worldwide.
- Gradual implementation is more likely to succeed.
- Enforce the dietary interventions to improve symptoms when chronic dialysis is not a treatment option or is to be postponed (vascular access maturation, organizing pre-emptive renal transplant, ..)
- If wasting is present, priority should be given to the correction of wasting.
- Compliance to diets should be monitored frequently during the first year of dietary intervention by dietary interviews (3 are optimal) and urine collection for urea output measures.
- Then yearly follow-up recommended until start of maintenance dialysis.

Intervention Recommendations - Nutritional Supplementation

KDOQI (2000)	KDOQI-AND (2019)	Changes
Indications for Nutritional 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 nutrition support. (Evidence and Opinion) • The period of inadequate intake after which nutritional support should be instituted ranges from days to 2 weeks, depending on the severity of the patient's clinical condition, degree of malnutrition (if any), and the degree of inadequacy of their nutritional intake. • Before considering nutrition support, the patient should receive a complete nutritional assessment. • Any potentially reversible or treatable condition or medication that might interfere with appetite or cause malnutrition should be eliminated or treated. • For nutrition support, the oral diet may be fortified with energy and protein supplements. • If oral nutrition (including nutritional supplements) is inadequate, tube feeding should be offered if medically appropriate. • If tube feedings are not used, intradialytic parenteral nutrition (IDPN; for hemodialysis) or intraperitoneal amino acids (IPAA; for peritoneal dialysis) should be considered if either approach in conjunction with existing oral intake meets the protein and energy requirements. • If the combination of oral intake and IDPN or IPAA does not meet protein and energy requirements, daily total or partial parenteral nutrition should be considered. • The dialysis regimen should be regularly monitored and modified to treat any intensification of the patient's uremic state that is caused by superimposed illness or increased protein intake.	**Oral Protein-Energy Supplementation** • In adults with **CKD 3-5D (2D) and post-transplant (OPINION) at risk of or with protein-energy wasting**, we suggest a minimum of a 3-month trial of oral nutritional supplements to improve nutritional status if dietary counselling alone does not achieve sufficient energy and protein intake to meet nutritional requirements.	Updated

Specifics of Oral Nutritional Supplementation

Who	All versus at-risk
When	During Dialysis; In between meals
How much	Replacement versus Supplementation
How long	> 3-months
How to monitor	Weight Biomarkers

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Intervention Recommendations - Nutritional Supplementation

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Intervention Recommendations - Nutritional Supplementation

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Indications for Nutritional 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 nutrition support. (Evidence and Opinion) • The period of inadequate intake after which nutritional support should be instituted ranges from days to 2 weeks, depending on the severity of the patient's clinical condition, degree of malnutrition (if any), and the degree of inadequacy of their nutritional intake. • Before considering nutrition support, the patient should receive a complete nutritional assessment. • Any potentially reversible or treatable condition or medication that might interfere with appetite or cause malnutrition should be eliminated or treated. • For nutrition support, the oral diet may be fortified with energy and protein supplements. • If oral nutrition (including nutritional supplements) is inadequate, tube feeding should be offered if medically appropriate. • If tube feedings are not used, intradialytic parenteral nutrition (IDPN; for hemodialysis) or intraperitoneal amino acids (IPAA; for peritoneal dialysis) should be considered if either approach in conjunction with existing oral intake meets the protein and energy requirements. • If the combination of oral intake and IDPN or IPAA does not meet protein and energy requirements, daily total or partial parenteral nutrition should be considered. • The dialysis regimen should be regularly monitored and modified to treat any intensification of the patient's uremic state that is caused by superimposed illness or increased protein intake.	**Intradialytic Parenteral Nutrition (IDPN) Protein-Energy Supplementation** • In adults with **CKD with protein-energy wasting**, we suggest a trial of TPN for CKD 1-5 patients **(2C)** and IDPN for CKD 5D on MHD patients **(2C)**, to improve and maintain nutritional status if nutritional requirements cannot be met with existing oral and enteral intake.	Updated

Intervention Recommendations - Nutritional Supplementation

KDOQI (2000)	KDOQI-AND (2019)	Changes
Indications for Nutritional 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 nutrition support. (Evidence and Opinion) • The period of inadequate intake after which nutritional support should be instituted ranges from days to 2 weeks, depending on the severity of the patient's clinical condition, degree of malnutrition (if any), and the degree of inadequacy of their nutritional intake. • Before considering nutrition support, the patient should receive a complete nutritional assessment. • Any potentially reversible or treatable condition or medication that might interfere with appetite or cause malnutrition should be eliminated or treated. • For nutrition support, the oral diet may be fortified with energy and protein supplements. • If oral nutrition (including nutritional supplements) is inadequate, tube feeding should be offered if medically appropriate. • If tube feedings are not used, intradialytic parenteral nutrition (IDPN; for hemodialysis) or intraperitoneal amino acids (IPAA; for peritoneal dialysis) should be considered if either approach in conjunction with existing oral intake meets the protein and energy requirements. • If the combination of oral intake and IDPN or IPAA does not meet protein and energy requirements, daily total or partial parenteral nutrition should be considered. • The dialysis regimen should be regularly monitored and modified to treat any intensification of the patient's uremic state that is caused by superimposed illness or increased protein intake.	**Dialysate Protein-Energy Supplementation** • In adults with **CKD on peritoneal dialysis with protein-energy wasting**, we suggest <u>not substituting</u> conventional dextrose dialysate with amino acid dialysate as a general strategy to improve nutritional status (2C), although in selected cases of protein-wasting when energy intake is adequate, 1.1% amino acid dialysate with alkali supplements may ameliorate protein deficits (OPINION).	Updated

Natural progression of nutritional interventions in patients with kidney disease

Intervention Recommendations - LC n-3 PUFA

KDOQI (2000)	KDOQI-AND (2019)	Changes
N/A	**LC n-3 PUFA Nutritional Supplements for Lipids, Mortality and CVD** • In adults with **CKD on MHD, PD (Opinion) or post-transplant**, we suggest not routinely prescribing long-chain n-3 PUFA, including those derived from fish or flaxseed and other oils, to lower risk of mortality (2C) or cardiovascular events (2B). • In adults with **CKD on MHD**, we suggest that 1.3-4 g/d long-chain n-3 PUFA may be prescribed to reduce triglycerides and LDL cholesterol (2C) and raise HDL levels (2D). • In adults with **CKD on PD**, it is reasonable to consider prescribing 1.3-4 g/d long-chain n-3 PUFA to improve the lipid profile (OPINION).	New

Intervention Recommendations - LC n-3 PUFA

KDOQI (2000)	KDOQI-AND (2019)	Changes
N/A	**LC n-3 PUFA Nutritional Supplements for AV Graft and Fistula Patency** • In adults with **CKD on MHD**, we suggest not routinely prescribing fish oil to improve primary patency rates in patients with AV grafts (2B) or fistulas (2A). **LC n-3 PUFA Nutritional Supplements for Kidney Allograft Survival** • In adults with **CKD with kidney allograft**, we suggest not routinely prescribing long-chain n-3 PUFA to reduce the number of rejection episodes or improve graft survival (2D).	New

Intervention Recommendations - Dietary Patterns

KDOQI (2000)	KDOQI-AND (2019)	Changes
Mediterranean Diet **N/A**	**Mediterranean Diet** • In adults with **CKD 1-5 (non-dialysis) and post-transplant**, with or without dyslipidemia, we suggest that prescribing a Mediterranean Diet may improve lipid profiles (2C).	New Weak, Conditional
Fruits and Vegetables **N/A**	**Fruits and Vegetables** • In adults with **CKD 1-4**, we suggest that prescribing increased fruit and vegetable intake may decrease body weight, blood pressure and net acid production (NEAP) (2C).	New Weak, Conditional

Generalities: Vitamins and Trace-Elements

Ideal amounts of daily vitamins and trace elements are those required to:

- Maintain health / prevent diseases
- Maintain nutritional status
- Reverse deficiencies
- Prevent toxicity

Recommendations for vitamins/trace element intakes are challenging

- Depend on physical properties (hydro vs fat-solubility)
- Depend on type of population: General population vs CKD patients
- Depend on body stores, previous supplementation, nutritional status and intake, Gut absorption, impaired renal metabolism, additional losses through dialysis

Recommended Dietary Allowances for Adult General Population

Micronutrients	Recommended Dietary Allowance (per day)
Thiamine	1.2mg (M), 1.1mg (F)
Vitamin B12	2.4µg (M & F)
Folic acid	400 µg (M & F)
Vitamin C	90mg (M), 75mg (F)
Vitamin D	10 µg (M), 5 µg (F)
Vitamin E	15mg (M & F)
Vitamin K	120 µg (M), 90 µg (F)
Selenium	55 µg (M & F)
Zinc	11mg (M), 8 mg (F)

Intervention Recommendations - Vitamins

KDOQI (2000)	KDOQI-AND (2019)	Changes
Folic Acid and B vitamins **N/A**	**Folic Acid Supplementation for Hyperhomocysteinemia** • In adults with **CKD 3-5D and post-transplant who have hyperhomocysteinemia associated with kidney disease**, we recommend not routinely supplementing folate with or without B-complex since there is no evidence demonstrating reduction in cardiovascular outcomes (1A). **Folic Acid Deficiency and Insufficiency** • In adults with **CKD 1-5 D (2B) and post-transplant (OPINION)**, we suggest prescribing folate, Vit B12 and/or B-complex supplement to correct for folate or Vitamin B12 deficiency/insufficiency (2B).	New

Intervention Recommendations - Vitamins

KDOQI (2000)	KDOQI-AND (2019)	Changes
Vitamin C **N/A**	**Vitamin C Supplementation Limit** • In adults with **CKD 1-5D and post-transplant who are at risk of Vitamin C deficiency** it is reasonable to consider supplementation to meet the recommended intake of at least 90 mg/d for men and 75 mg/d for women (OPINION).	New
Vitamin K **N/A**	**Anticoagulant Medication and Vitamin K Supplementation** • In adults with **CKD 1-5D and post-transplant**, it is reasonable that patients receiving anticoagulant medicines known to inhibit vitamin K activity (e.g., warfarin compounds) do not receive vitamin K supplements (OPINION).	

Intervention Recommendations - Vitamins

KDOQI (2000)	KDOQI-AND (2019)	Changes
Vitamin E and A **N/A**	**Vitamins A and E Supplementation and Toxicity** • In adults with **CKD on MHD or PD**, it is reasonable to not routinely suggest vitamin A or E supplementation because of the potential for vitamin toxicity. However, if supplementation is warranted, it is reasonable to use caution and monitor patients for toxicity (OPINION).	New

Intervention Recommendations - Vitamins

KDOQI (2000)	KDOQI-AND (2019)	Changes
Vitamin D **N/A**	**Vitamin D Supplementation for Vitamin D Deficiency and Insufficiency** • In adults with **CKD 1-5 D (2C) and post-transplant (OPINION),** we suggest prescribing vitamin D supplementation in the form of cholecalciferol or ergocalciferol to **correct 25(OH)D deficiency or insufficiency**. **Vitamin D Supplementation with Proteinuria** • In adults with **CKD with chronic nephrotic range proteinuria**, it is reasonable to consider supplementation of cholecalciferol, ergocalciferol or other safe and effective 25(OH)D precursors **(OPINION).**	New

Intervention Recommendations - Acid Base Balance

KDOQI (2000)	KDOQI-AND (2019)	Changes
Measurement of Serum Bicarbonate • Serum bicarbonate should be measured in maintenance dialysis patients once monthly. (Opinion)	**Dietary Management of net acid production (NEAP)** • In adults with **CKD 1-4**, we suggest reducing net acid production (NEAP) through increased dietary intake of fruits and vegetables (2C) in order to reduce the rate of decline of residual kidney function.	Updated
Treatment of Low Serum Bicarbonate • Predialysis or stabilized serum bicarbonate levels should be maintained at or above 22 mmol/L. (Evidence and Opinion)	**Bicarbonate Maintenance** • In adults with **CKD 3-5D**, we suggest reducing net acid production (NEAP) through increased bicarbonate supplementation (1C) in order to reduce the rate of decline of residual kidney function. • In adults with **CKD 3-5D**, it is reasonable to maintain serum bicarbonate levels at 24 - 26 mmol/L (OPINION).	Updated

Intervention Recommendations - Electrolytes

KDOQI (2000)	KDOQI-AND (2019)	Changes
Phosphorus **N/A**	**Dietary Phosphorus Amount** • In adults with **CKD 3-5 and on MHD**, we recommend adjusting dietary phosphorus intake to maintain serum phosphate levels in the normal range (1B). **Dietary Phosphorus Source** • In adults with **CKD 1-5D and post-transplant**, it is reasonable when making decisions about phosphorus restriction treatment to consider the bioavailability of phosphorus sources (e.g. animal, vegetable, additives) (OPINION). **Phosphorus Intake with Hypophosphatemia** • For adult **kidney transplant recipients with hypophosphatemia**, it is reasonable to consider prescribing high-phosphorus intake (diet or supplements) in order to replete serum phosphorus (OPINION).	New

Intervention Recommendations - Electrolytes

KDOQI (2000)	KDOQI-AND (2019)	Changes
Calcium **N/A**	**Calcium Intake** • In adults with **CKD 3-4** not taking active vitamin D analogs, we suggest that a total elemental calcium intake of **800-1,000 mg/d (including dietary calcium, calcium supplementation and calcium-based phosphate binders)** be prescribed to maintain a neutral calcium balance (2B).	New

Intervention Recommendations - Electrolytes

KDOQI (2000)	KDOQI-AND (2019)	Changes
Sodium **N/A**	**Sodium Intake and Blood Pressure** • In adults with **CKD 3-5 (non-dialyzed) (1B), maintenance dialysis (1C), and post-transplant (1C),** we recommend limiting sodium intake to less than **100 mmol/day (or <2.3 g/day)** to reduce blood pressure and improve volume control. **Sodium Intake and Proteinuria** • In adults with **CKD 3-5 (non-dialyzed),** we suggest that reduced sodium intake 100 mmol/day (or <2.3 g/day) be prescribed to reduce proteinuria (2A). **Sodium Intake and Dry Body Weight** • In adults with **CKD 3-5D,** we suggest reduced sodium intake as an adjunctive lifestyle modification strategy to achieve better volume control and a more desirable body weight (2B).	New

Intervention Recommendations - Electrolytes

KDOQI (2000)	KDOQI-AND (2019)	Changes
Potassium **N/A**	**Dietary Potassium Amount** • In adults with **CKD 3-5D and post- transplant**, it is reasonable to adjust dietary potassium intake to maintain serum potassium within the normal range (OPINION). **Dietary Potassium in Hyperkalemia** • In adults with **CKD 3-5D and post-transplant who exhibit hyperkalemia**, it is reasonable to consider lowering dietary potassium intake as a therapeutic strategy (OPINION). **Potassium Intake for Hyperkalemia or Hypokalemia** • In adults with **CKD 3-5 on MHD (2D) and post-transplant (OPINION)** with either hyperkalemia or hypokalemia, we suggest that dietary or supplemental potassium intake be based on a patient's individual needs and clinician judgment.	New

Thank you!

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Additional Resources

- A Clinical Guide to Nutrition Care in Kidney Disease (Academy)
- National Kidney Diet (Academy)
- Pocket Guide to Nutrition Assessment of the Patient with Kidney Disease (NKF)
- Renal Dietitian Certificate of Training (Academy)
- Standards of Practice and Standards of Professional Performance for Renal Dietitians (Academy)
- Strategies I: Essentials of Nutrition Practice for Chronic Kidney Disease (NKF SCM)
- Strategies II: Advanced Practice in Renal Nutrition (NKF SCM)
- Webinar Series: Nutrition in CKD Guideline Update (NKF & Academy)

NKF: www.kidney.org

Academy: www.eatright.org

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