Pocket Guide to Nutrition Assessment of the Patient with Kidney Disease

6th Edition

NATIONAL KIDNEY FOUNDATION®

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FOREWORD

Every effort was made to obtain and provide the most up-to-date, accurate information for this 6th edition of the Pocket Guide. Older references are typically for classic information that is unchanged. Websites have been included where pertinent and other references have been updated.

For those who are unfamiliar with this resource, the primary goal is to compile CKD nutrition information in a concise, abbreviated format. Achieving a balance between too much and too little information is challenging because of the wide variation in practice and knowledge within the target audience. For experienced clinicians, this book provides concentrated information that is known and used on a regular basis. For less experienced clinicians, it provides a foundation on which to build expertise. Overall, the goal is to help nephrology dietitians provide consistent, high-quality nutrition care for all patients with kidney disease.

This book is not all-inclusive. The information is a compilation of many sources and input from experienced nephrology dietitians. It is not intended to dictate clinical practice but to provide practical information. It is the responsibility of each individual clinician to keep his or her knowledge base current. Additionally, clinicians may need to update or modify this information in line with new evidence-based recommendations, oversight mandates, and/or the policies and procedures of their employers.

I truly appreciate the secondary reviewers for their conscientious reviews and suggestions.

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ACRONYMS AND ABBREVIATIONS

A1C – Glycosylated or glycated hemoglobin
AA/aa – Amino acid
ABW – Adjusted body weight
ACE – Angiotensin-converting enzyme
ACEi – Angiotensin-converting enzyme inhibitor
ACR – Albumin-to-creatinine ratio
ADAG – A1C-derived average glucose
ADHD – Attention-deficit/hyperactivity disorder
ADI – Acceptable daily intake
Adj – Adjusted
AEB – As evidenced by
AHA – American Heart Association
AI – Adequate intake
AIDS – Acquired immune deficiency syndrome
AKI – Acute kidney injury
AKIN – Acute Kidney Injury Network
ALP – Alkaline phosphatase
AND – Academy of Nutrition and Dietetics
ANDHII – Academy of Nutrition and Dietetics Health Information Infrastructure
APD – Automated peritoneal dialysis
APP – Acute phase protein
APR – Acute phase reactant
ARB – Angiotensin receptor blocker
ARF – Acute renal failure
Art – Arterial
ASN – American Society of Nephrology
ASPEN – American Society of Parenteral and Enteral Nutrition
Ave – Average
AVF – Arteriovenous fistula
AVG – Arteriovenous graft
BCG – Bromocresol green
BEE – Basal energy expenditure
BFR – Blood flow rate
BG – Blood glucose
BIA – Bioelectrical impedance analysis
BID – Twice a day
BK – Below the knee
BKA – Below the knee amputation
BMD – Bone and mineral disorder
BMI – Body mass index
BP – Blood pressure
BRAT – Bananas, rice, applesauce, toast (diet)
BSA – Body surface area
BUN – blood urea nitrogen
BW – Body weight
Ca^{++} – Calcium
CAD – Coronary artery disease
CaOx – Calcium oxalate
CAPD – Continuous ambulatory peritoneal dialysis
CaSR – Calcium-sensing receptor
CAVH – Continuous arteriovenous hemofiltration
CAVHD – Continuous arteriovenous hemodialysis
CBC – Complete blood count
CCPD – Continuous cyclic peritoneal dialysis
CDR – Commission on Dietetic Registration

CERA – Continuous erythropoietin receptor activator
CfC – Conditions for Coverage
CGM – Continuous glucose monitoring
CGMI – Continuous glucose management indicator
C-HD – Continuous hemodialysis
C-HDF – Continuous hemodiafiltration
C-HF – Continuous hemofiltration (also called CVVH or CRRT)
CHF – Congestive heart failure
CHO – Carbohydrate
CHOL – Cholesterol
CHr – Content of hemoglobin in reticulocytes
CI – Creatinine index
CKD – Chronic kidney disease
CKD-MBD – Chronic kidney disease mineral and bone disorder
Cmax – maximum plasma concentration
CMS – Centers for Medicare & Medicaid Services
COPD – Chronic obstructive pulmonary disease
Cp – Ceruloplasmin
CPG – Clinical practice guideline
CPR – Clinical practice recommendation
CPT – Current procedural terminology
Cr - Creatinine
CrCl – Creatinine clearance
CRP – C-reactive protein
CRRT – Continuous renal replacement therapy
CUA – Calcific uremic arteriolopathy
CV – Cardiovascular
CVA – Cerebrovascular accident
CVC – Central venous catheter
CVD – Cardiovascular disease
CVVH – Continuous veno-venous hemofiltration
CVVHD – Continuous veno-venous hemodialysis
CVVHDF – Continuous veno-venous hemodiafiltration
d – Day
D2 – Ergocalciferol
D3 – Cholecalciferol
DASH – Dietary Approached to Stop Hypertension (diet)
DBP – Diastolic blood pressure
DBW – Desirable body weight
D/C – Discontinue
DCCT – Diabetes Control and Complications Trial
Decr – Decreased (also signified by ↓)
DEI – Dietary energy intake
DFR – Dialysate flow rate
DM – Diabetes mellitus
DOPPS – Dialysis Outcomes and Practice Patterns Study
DPI – Dietary protein intake
DPP-4 – Dipeptidyl peptidase-4
DPVV – Double pool, variable volume
DRI – Dietary reference intake
DSMT – Diabetes Self-Management Training
D/T – Due to
DTR – Registered dietetic technician
DUN – Dialysis urea nitrogen
DW – Dry weight
DXA – Dual energy X-ray absorptiometry
EAA – Essential amino acid
eAG – Estimated average glucose
ECG – Electrocardiogram
EDW – Estimated dry weight

EER – Estimated energy requirement
EFA – Essential fatty acid
eKt/V – Equilibrated Kt/V (see Kt/V)
EMA – European Medicines Agency
EN – Enteral nutrition
eNCPT – Electronic nutrition care process terminology
EPO – Erythropoietin
Eq – Equivalent
ESA – Erythropoiesis-stimulating agent
ESKD – End-stage kidney disease
ESPEN – European Society for Clinical Nutrition and Metabolism
ESR – Erythrocyte sedimentation rate
ESRD QIP – End-Stage Renal Disease Quality Incentive Program
ETOH – Alcohol
EU – European Union
Exch – Peritoneal dialysis exchange
F – Female
FA – Fatty acid; folic acid
FDA – United States Food and Drug Administration
Fe – Iron
FF – Flow fraction
FFA – Free fatty acid
FFQ – Food frequency questionnaire
FGF – Fibroblast growth factor
FPG – Fasting plasma glucose
g – Gram
GDM – Gestational diabetes mellitus
GFR – Glomerular filtration rate
GI – Gastrointestinal
GLIM – Global Leadership Initiative on Malnutrition
GLP-1RA – glucagon-like peptide 1 receptor agonist
GRAS – Generally recognized as safe
GU – Urea generation rate
HA – Headache
HAART – highly active antiretroviral therapy
Hb – Hemoglobin
HbA1C – Glycosylated or glycated hemoglobin
HBV – High biological value
Hct – Hematocrit
HD – Hemodialysis
HDL – High-density lipoprotein
HDL-C – High-density lipoprotein cholesterol
HFC – High-fructose corn syrup
HIF-PHI – Hypoxia inducible factor-prolyl hydroxylase inhibitors
HIV – Human immunodeficiency virus
HMG-CoA reductase – Hydroxy-methyl-glutaryl coenzyme A reductase
HN – High nitrogen
HP – High protein
HPT – Hyperparathyroidism
hr – Hour
%HRC – Percentage of hypochromic red blood cells
hsCRP – Highly sensitive C-reactive protein
ht – Height
HTN – Hypertension
IBW – Ideal body weight
IBS – Inflammatory bowel syndrome
ICU – Intensive care unit
ID – Interdialytic
IDPN – Intradialytic parenteral nutrition

IDT – Interdisciplinary team
IDWG – Interdialytic weight gain
IFG – Impaired fasting glucose
IGF – Insulin-like growth factor
IGT – Impaired glucose tolerance
IHD – Intermittent hemodialysis
IL – interleukin
IM – Intramuscular
Incr – Increased (also signified by ↑)
IPAA – Intraperitoneal amino acids
IPD – Intermittent peritoneal dialysis
IPN – Intraperitoneal nutrition
iPTH - Intact parathyroid hormone
IS – Indoxyl sulfate
ISRNM – International Society of Renal Nutrition and Metabolism
IV – Intravenous
K – Clearance
K^+ – Potassium
KA – Ketoacid analog
kat – Katal
kcal – Kilocalories
KDIGO – Kidney Disease Improving Global Outcomes
KDOQI – Kidney Disease Outcomes Quality Initiative
kj – Kilojoules
KRT – kidney replacement therapy
KrU – Residual urea clearance
Kt/V – Unitless measure of dialysis adequacy
LBM – Lean body mass
LBW – Lean body weight
LC n-3 PUFA - long-chain n-3 polyunsaturated fatty acids
LDL – Low-density lipoprotein
LDL-C – Low-density lipoprotein cholesterol
Ln – Natural log
LOS – Length of stay
LP – Low protein
Lp-a – Lipoprotein a
LPS – Lipopolysaccharide
LV – Left ventricular
LVH – Left ventricular hypertrophy
M – Male
MAC – Mid-arm circumference
MAMA – Mid-arm muscle area
MAMC – Mid-arm muscle circumference
MAO – Monoamine oxidase
MAOI – Monoamine oxidase inhibitor
MBD – Mineral and bone disorder
MCC – Major comorbid conditions
MCH – Mean corpuscular hemoglobin
MCHC – Mean corpuscular hemoglobin concentration
MCV – Mean corpuscular volume
MD – Maintenance dialysis
MDRD – Modification of Diet in Renal Disease study
Mg – Magnesium
MHD – Maintenance hemodialysis
MI – Myocardial infarction; also motivational interviewing
min – Minute
MIS – Malnutrition Inflammation Score
M/M – Morbidity/mortality
MNT – Medical nutrition therapy
mo – Month

MODY – Maturity-onset diabetes mellitus in the young
mol – Mole
MRSA – Methicillin-resistant *Staphylococcus* aureus
MSJE – Mifflin-St. Jeor Equation
MVT – Multivitamin
Na^+ – Sodium
NA – Not available
NAM – Nicotinamide
NB – Nitrogen balance
NCDS – National Cooperative Dialysis Study
NCP – Nutrition care process
NCPM – Nutrition care process model
ND – Not on dialysis
NEAP – Net estimated acid production
Neg – Negligible
NGT – Nasogastric tube
NHANES – National Health and Nutrition Examination Survey
NHD – Nocturnal hemodialysis Nia – Niacin
NIH – National Institutes of Health
NIPD – Nocturnal intermittent peritoneal dialysis
NIR – Near infrared interactance radiation
NKDEP – National Kidney Disease Education Program
NKF – National Kidney Foundation
NL – Normal limits
NODAT – New-onset diabetes after transplantation
nPCR – Normalized protein catabolic rate
nPNA – Normalized protein nitrogen appearance
NSAID - Non-steroidal anti-inflammatory drug
N&V or N/V – Nausea and vomiting
OIG – Office of Inspector General
ONS – Oral nutrition supplement
OTC – Over-the-counter
oz – Ounce
P – Phosphorus
PA – Physical activity
PA – Pyrrolizidine alkaloid
PA – Plasma albumin, prealbumin
PAL – Physical activity level
PAM – Patient Activation Measure
PCC – People centered care
PCR – Protein catabolic rate
PCRn – Normalized protein catabolic rate
PCS – p-Cresyl sulfate
PD – Peritoneal dialysis
P-E – Protein energy
Peds – Pediatric
PEG – Percutaneous endoscopic gastrostomy
PEM – Protein-energy malnutrition
PES – Problem/etiology/signs and symptoms
PET – Peritoneal equilibration test
PEU – Protein/energy undernutrition
PEW – Protein-energy wasting
PG – Patient-generated
PI – Package insert
PLAG – percutaneous laparoscopic-assisted gastrostomy
PN – Parenteral nutrition
PNA – Protein equivalent of total nitrogen appearance
POC – Plan of care
Post BUN – Blood urea level at the end of HD treatment
PPS – Prospective Payment System

PRCA – Pure red cell aplasia
Pre BUN – Blood urea level prior to dialysis treatment
PRNT – Pediatric Renal Nutrition Task Force
pro – Protein
pt – Patient
PT – Parathyroid
PTH – Parathyroid hormone
PUFA – Polyunsaturated fatty acid
PVD – Peripheral vascular disease
Q – Each
QAPI – Quality Assurance and Performance Improvement
Qb – Blood flow rate (also termed BFR)
Qd – Dialysate flow rate (also termed DFR)
QOL – Quality of life
RAAS – Renin-angiotensin-aldosterone system
RA-UK – Renal Association, United Kingdom
RBC – Red blood cell
RBP – Retinol binding protein
RCT – Randomized controlled trial
RDA – Recommended dietary allowance
RDI – Recommended dietary intake
RDN – Registered dietitian nutritionist
Rec – Recommendation or recommend
REE – Resting energy expenditure
Retic – Reticulocyte
rhGH – Recombinant human growth hormone
RI – Reticulocyte index
RIFLE – Risk, Injury, Failure, Loss, End-Stage Renal Disease
RIG – Radiologically inserted gastrostomy
RKF – Residual kidney function
RMR – Resting metabolic rate
R/O – Rule out
RO – Reverse osmosis, renal osteodystrophy
Rx – Prescription
SA – Serum albumin
SBP – Systolic blood pressure
SBW – Standard body weight
SC – Subcutaneous
SCr – Serum creatinine
SCUF – Slow continuous ultrafiltration
SD – Standard deviation
SDS – Standard deviation score
SDHD – Short daily hemodialysis
SDI – Suggested Dietary Intake
SDS – Standard deviation scores
sec – Second
SGA – Subjective Global Assessment
SGLT2 – sodium-glucose cotransporter 2
SGLT2i – sodium-glucose cotransporter 2 inhibitor
SHPT – Secondary hyperparathyroidism
SI – International system of units
SL – Standardized language
SLE – Systemic lupus erythematosus
SLED – Sustained, low-efficiency dialysis
SMBG – self-monitoring blood glucose
SOB – Shortness of breath
SOBP – Standardized office blood pressure
spKt/V – Single pool Kt/V
SPS – Sodium polystyrene sulfonate
spvv – Single pool variable volume

SRI – Solute removal index
S/S – Signs and symptoms
SU – Serum urea
Suppl – Supplement
sx – Symptom
t – Time
Tbsp – Tablespoon
TB – Tuberculosis
TBD – To be determined
TBW – Total body water
TEE – Total energy expenditure
TFA – Trans-fatty acid
TG – Triglyceride
TIBC – Total iron-binding capacity
TID – Three times a day
TLC – Therapeutic lifestyle changes
TNA – Total nitrogen appearance
TNF – Tumor necrosis factor
TPD – Tidal peritoneal dialysis
TPN – Total parenteral nutrition
TSat – Transferrin saturation
TSF – Triceps skinfold
TSH – Thyroid stimulating hormone
tsp – Teaspoon
Tx – Treatment
TZD – Thiazolidinedione
UBW – Usual body weight
UF – Ultrafiltration
UFR – Ultrafiltration rate
UKM – Urea kinetic modeling
ULT – Urate lowering therapy
UNA – Urea nitrogen appearance
Unk – Unknown
URR – Urea reduction ratio
URS – Uremic retention solute
US – United States (as adjective only)
USDA – United States Department of Agriculture
USP – United States Pharmacopeia
USRDS – United States Renal Data System
UTI – Urinary tract infection
UUN – Urine urea nitrogen
V – Volume
VA – Vascular access
VDR – Vitamin D receptor
Ven – Venous
Vit – Vitamin
VLDL – Very low-density lipoprotein
VLPD – Very low protein diet
VSA – Volume from surface area
Vu – Volume of urine
WC – Waist circumference
WHR – Waist-to-hip ratio
wk – Week
WNL – Within normal limits
wt – Weight
× – Times (also signified by *)
yr – Year

NOMENCLATURE FOR KDIGO and KDOQI GUIDELINES

The strength of KDIGO and KDOQI recommendations are indicated as Level 1, Level 2, or not graded. The quality of the supporting evidence is shown as A, B, C, or D.

	Implications		
Grade	**For Patients**	**For Clinicians**	**For Policy Makers**
Level 1 "Recommend"	Most people in your situation would want the recommended course of action and only a small proportion would not.	Most patients should receive the recommended course of action.	The recommendation can be evaluated as a candidate for developing a policy or performance measure.
Level 2 "Suggest"	The majority of people in your situation would want the recommended course of action but many would not.	Different choices will be appropriate for different patients; each needs help to arrive at a management decision consistent with his/her values/ preferences.	The recommendation is likely to require substantial debate and involvement of stakeholders before policy can be determined.
Not Graded	Provides guidance based on common sense or when the topic does not allow adequate application of evidence. This category is most commonly used for monitoring intervals, counseling, and referral to other clinical specialists and written as simple declarative statements. They are not meant to be stronger than level 1 or 2 recommendations.		

Grade	Quality of Evidence	Meaning
A	High	We are confident that the true effect lies close to the estimate of the effect.
B	Moderate	The true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
C	Low	The true effect may be substantially different from the estimate of the effect.
D	Very Low	The estimate of effect is very uncertain and often will be far from the truth.

INTRODUCTION

While this is not a typical introduction, I felt that the Clinical Practice Guidelines for Nutrition in Chronic Kidney Disease (CKD) 2020 Update, should be included first and foremost to allow readers a concise review prior to delving into the chapters in the Pocket Guide (PG). These evidence-based guidelines were developed through a rigorous process that was applied by well-respected, high-level nutrition, research, and analytic experts. Information throughout the PG has been updated as appropriate to reflect the published guidelines. Due to the lack of quality evidence in many areas of CKD nutrition care, many recommendations are based on opinion or they advise clinicians to use their professional judgement. Previous editions of the PG included practical information that was based on historical nutrition care, common clinical practices, expert opinions, and reasonable expectations. Much of the information is considered helpful by nephrology clinicians, thus will continue to be included. It was decided to not to remove the original content unless it was contraindicated or redefined by the guidelines. This allows the reader to review and use methods, procedures, techniques, recommendations from the past when the evidence-based guideline is not definitive. It also provides written documentation for performing various nutrition assessment methods or techniques that may already be a part of dialysis providers nutrition care standards. Continuation of those standards has the potential to enhance the value of data collection from the past where serial measurements have been recorded to assess status of the population or demonstrate the efficacy of treatment.

For example, the guidelines suggest using clinical judgment to determine the method for measuring BW (actual, wt history, serial wt measures, adjustments for edema, ascites, polycystic kidney disease) due to absence of standard reference norms. The descriptions of various BW measures included in Chapter 1 may help determine which method to use or precisely define a method that is already established within your clinical practice setting.

None of the information in the PG is meant to undermine or contradict the guidelines. We have made every effort to align the content with the guidelines, but also continue to provide other information that may be of value to nephrology clinicians, especially where guideline information is lacking or not definitive. The brief overview in the following pages provide all the guideline statements. Each individual chapter has been reviewed and updated as appropriate in relation to the published guidelines with italicized text. It is strongly recommended that you read the entire published guideline document to avail yourself of the extensive evidence and expert opinions. The detail in the document is extremely informative and helpful as you make your clinical decisions and guide your employers if they may choose to revise their nutrition standards of practice.

These guidelines are designed to provide information and assist decision making, but not designed to define a standard of care and should not be construed as a standard or be interpreted as prescribing an exclusive course of management. Delivery of nutrition care for those with CKD must consider individual patient needs, available resources, and limitations that are unique to an institution or type of practice. Each health-care professional using the recommendations is responsible for evaluating the appropriateness of applying them in the specific clinical situations. The guideline is for adults, age 18 or older.

GUIDELINE 1: NUTRITIONAL ASSESSMENT

Guideline Topic	CKD Stage	Guideline Statement	GRADE	Rationale
1.0 General Statements				
Screening	3-5D, posttransplantation	1.01 reasonable to consider routine nutrition screening at least biannually with intent of identifying risk for PEW	O	
Tools	Same as above	1.0.2 limited evidence to the use of one tool over another to identify risk of PEW	2D	
Routine assessment	Same as above	1.0.3 reasonable to conduct a comprehensive nutritional assessment including but not limited to appetite, diet history, BW and BMI, biochemical data, anthropometric measures, and nutrition focused physical exam within the first 90 days of dialysis, annually, or when indicated by nutrition screening or provider referral	O	Completed by RDN or international equivalent

GUIDELINE 1: NUTRITIONAL ASSESSMENT (cont.)

Guideline Topic	CKD Stage	Guideline Statement	GRADE	Rationale
1.1 Technical Devices & Anthropometrics				
Bioimpedance	MHD	1.1.1 suggest using BIA, preferable multi-frequency BIA to assess body composition if available; perform > 30 min after end of HD session	2C	
	CKD, PD	1.1.2 insufficient evidence to suggest BIA	2D	
DXA	1-5D, posttransplantation	1.1.3 reasonable to use DXA when feasible (gold standard for measuring body composition)	O	
BW/BMI	Same as above	1.1.4 reasonable to consider assessing body composition in combination with BW/BMI at 1st visit and periodically over time	O	
Frequency of BW/BMI	Same as above	1.1.5 for clinically stable measure/monitor changes at least: Monthly (MHD, PD) Every 3 mo (CKD 4-5, posttransplantation) Every 6 mo (CKD 1-3)	O	
Body Weight	Same as above	1.1.6 reasonable to use clinical judgement to determine method for measuring BW (actual, wt history, serial wt measures, adjustments for edema, ascites, and polycystic kidney disease) due to absence of standard reference norms	O	Completed by RDN/international equivalent or physician
BMI as predictor of mortality	PD	1.1.7 suggest underweight status based on BMI be used to predict higher mortality	2C	

Guideline Topic	CKD Stage	Guideline Statement	GRADE	Rationale
1.1 Technical Devices & Anthropometrics (cont.)				
	MHD	1.1.8 suggest use overweight/obese BMI as predictor of ↓ mortality; underweight/ morbid obesity as predictor of ↑ mortality	2B	
	CKD 1-5,	1.1.9 reasonable to consider underweight BMI as predictor of ↑ mortality, but overweight/ obesity risk is unclear	O	
	Posttransplantation	1.1.10 reasonable to consider underweight and overweight/obesity as predictor of ↑ mortality	O	
BMI/PEW	CKD 1-5D, posttransplantation	1.1.11 BMI alone not sufficient to establish PEW unless very low (<18 kg/m^2)	O	(<18 kg/m2)
Skinfold Thickness	Same as above	1.1.12 in absence of edema suggest use of skinfold thickness measures to assess body fat	O	Lack of reference standards, need for training/accuracy
Waist Circumference	5D	1.1.13 suggest that waist circumference may be used to assess abdominal obesity	2C	Reliability over time is low
Conicity Index (of abdominal obesity)	MHD	1.1.14 may be used to assess nutritional status and as predictor of mortality	2C	Risk indicator of for hyperlipidemia in Western populations
Creatinine Kinetics	5D	1.1.15 suggest it may be used to estimate muscle mass	2C	Diet and/or creatine supplements will influence accuracy; requires urine collection

GUIDELINE 1: NUTRITIONAL ASSESSMENT (cont.)

Guideline Topic	CKD Stage	Guideline Statement	GRADE	Rationale
1.2 Laboratory Measures				
Biomarkers (nPCR, albumin, PAB)	1-5 D, posttransplantation	1.2.1 may be considered as complimentary tools to assess nutritional status, but not in isolation because of non-nutritional factors	O	
Serum Albumin	5D	1.2.2 may be used as a predictor of hospitalization/mortality; lower levels associated with ↑ risk	1A	Note: BCG method is recommended for use in those with ESKD
1.3 Handgrip Strength				
Handgrip strength	1-5D	1.3.1 suggest using handgrip strength as an indicator of protein-energy and functional status when baseline data (prior measures) are available for comparison	2B	Requires special equipment but simple to perform
1.4 Assessing Energy Requirements				
Assessing REE	1-5D, posttransplantation	1.4.1 reasonable to use indirect calorimetry to measure REE	O	Gold standard, use when feasible and indicated
Resting Energy Equations	CKD5	1.4.2 in metabolically stable, suggest using disease-specific predictive energy equations (if indirect calorimetry not possible)	2C	Some studies suggest CKD requirements may be like healthy adults

Guideline Topic	CKD Stage	Guideline Statement	GRADE	Rationale
1.5 Composite Nutritional Indices				
7-point SGA	5D	1.5.1 recommend the use of 7-point SGA as a valid and reliable tool for assessing nutritional status	1B	11 studies
MIS	5D, posttransplantation	1.5.2 may be used to assess nutritional status	2C	8 studies
Note: a comprehensive nutrition assessment, using a composite nutritional index should be conducted at the initial visit and completed whenever there is a change in health status or as directed by institutional or regulatory policies.				
1.6 Tools/Methods Used to Assess Protein and Calorie Intake				
Considerations when assessing Dietary Intake (DI)	3-5D, posttransplantation	1.6.1 reasonable to assess factors beyond DI (medication use, knowledge, beliefs, attitudes, behaviors, access to food, depression, cognitive function, etc.) to plan nutrition interventions	O	
3-day Food Records	3-5D	1.6.2 suggest the use of 3-day food record as the preferred method to assess dietary intake	2C	Conduct during both dialysis and non-dialysis day (as applicable)
Alternative Methods for Assessing DI	3-5	1.6.3 24-hr food recalls, food frequency questionnaires, and	O	
	5D	nPCR may be considered as alternative methods of assessing dietary intake	2D	nPCR requires 24-hr urine collection for accuracy

GUIDELINE 2: MEDICAL NUTRITION THERAPY

Guideline Topic	CKD Stage	Guideline Statement	GRADE	Rationale
2.0 Medical Nutrition Therapy				
MNT to Improve Outcomes	1-5D	2.0.1 recommend providing MNT to optimize nutritional status, and minimize risks of comorbid conditions and alterations in the metabolism on the progression of kidney disease and on adverse clinical outcomes	1C O	RDN or international equivalent, in close collaboration with a physician or other provider (NP or PA)
MNT Content	1-5D, posttransplantation	2.0.2 reasonable to prescribe MNT that is tailored to the individuals' needs, nutritional status, and comorbid conditions	O	
MNT Monitoring and Evaluation	3-5D, posttransplantation	2.0.3 reasonable to monitor and evaluate appetite, dietary intake BW changes, biochemical data, anthropometric measures, and nutrition-focused physical findings to assess efficacy of MNT	O	RDN or international equivalent

GUIDELINE 3: PROTEIN AND ENERGY INTAKE

Guideline Topic	CKD Stage	Guideline Statement	GRADE	Rationale
3.0 Protein Amount				
Protein Restriction, Non-dialysis, Without DM	3-5	3.0.1 in metabolically stable, recommend protein restriction with or without keto-acid analogs to reduce risk of ESKD death and improve quality of life Low protein 0.55 to 0.6 g/kg BW/d Very-low protein diet 0.28-0.43 g/kg BW/d with additional keto analogs to meet the 0.55-0.6 g/kg requirement	1A 2C	Restriction should be closely supervised by an RDN or international equivalent in collaboration with a physician
Protein Restriction, Non-dialysis, With DM	3-5	3.0.2 reasonable to prescribe a dietary protein intake of 0.6-0.8 g/kg BW/d to maintain stable nutritional status and optimize glycemic control	O	Supervised by an RDN or international equivalent in collaboration with a physician
Protein Intake, MHD, PD Without DM	5D (MHD) 5D (PD)	3.0.3 in metabolically stable recommend prescribing DPI of 1.0-1.2 g/kg BW/d to maintain stable nutritional status Same as above	1C O	
Protein Intake MHD, PD With DM	5D	3.0.4 reasonable to prescribe DPI of 1.0-1.2 g/kg BW/d to maintain stable nutritional status	O	Consider ↑ if at risk for hyper/hypoglycemia

GUIDELINE 3: PROTEIN AND ENERGY INTAKE (cont.)

Guideline Topic	CKD Stage	Guideline Statement	GRADE	Rationale
3.1 Energy Intake				
Energy Intake	1-5D	3.1.1 in metabolically stable, recommend prescribing an energy intake of 25-35 kcal/kg/BW/d to maintain normal nutritional status (based on age, sex, physical activity, body composition, weight status goals, CKD stage, concurrent illnesses, inflammation)	1C	
	Posttransplantation	Same as above	O	
3.2 Protein Type				
Protein Type	1-5D	3.2.1 there is insufficient evidence to recommend a particular protein type (plant or animal) in terms of effects on nutritional status, Ca or P levels, or blood lipid levels	1B	There is increasing interest in vegetable-based diets, but evidence is limited
	Posttransplantation	Same as above	O	
3.3 Dietary Patterns				
Mediterranean Diet	1-5, non-dialysis, posttransplantation	3.3.1 with or without dyslipidemia suggest that prescribing a Mediterranean Diet may improve lipid profiles	2C	
Fruits and Vegetables	1-4	3.3.2 suggest prescribing increased fruit and vegetable intake may decrease BW, BP, and NEAP	2C	

GUIDELINE 4: NUTRITIONAL SUPPLEMENTATION

Guideline Topic	CKD Stage	Guideline Statement	GRADE	Rationale
4.1 Oral Protein-Energy Supplementation				
Oral Protein-Energy Supplements	3-5D	4.1.1 in those at risk for or with PEW suggest a minimum 3-mo trial of oral nutrition supplements if dietary counseling alone does not achieve sufficient energy and protein intake to meet nutritional requirements	2D	To improve nutritional status
	Posttransplantation	As above	O	
Enteral Nutrition Supplementation				
Enteral Nutrition	1-5D	4.1.2 in those with chronically inadequate intake and whose pro/energy needs cannot be met by dietary counseling and oral nutritional supplements, it is reasonable to consider a trial of enteral tube feeding	O	
TPN and IDPN	1-5D	4.1.3 in those with PEW, suggest a trial of TPN for CKD and IDPN for MHD	2C	To improve nutritional status if nutrition requirements cannot be met with existing oral and enteral intake

GUIDELINE 4: NUTRITIONAL SUPPLEMENTATION (cont.)

Guideline Topic	CKD Stage	Guideline Statement	GRADE	Rationale
4.2 Nutrition Supplementation – Dialysate				
Dialysate	5D (PD)	4.2.1 PD with PEW suggest not substituting conventional dextrose dialysate with aa dialysate to improve nutritional status, although it is reasonable to consider a trial of aa dialysate to improve and maintain nutritional status if nutritional needs cannot be met with existing oral and enteral intake	O	Variable study results on different outcomes, long-term effects remain unclear
4.3 Long Chain Omega-3 Polyunsaturated Fatty Acids				
LC n-3 PUFA Nutritional Supplements: Mortality and CV Disease				
LC n-3 PUFA for Mortality and CV disease	MHD, posttransplantation	4.3.1 suggest not routinely prescribing LC n3 PUFA (including those from fish, flaxseed, or other oils to ↓ risk for mortality or CV events	2C 2B	
As above	PD	4.3.2 Same as above	O	
LC n-3 PUFA Nutritional Supplements: Lipid Profiles				
LC n-3 PUFA for Lipid Profile	5D (MHD)	4.3.3 suggest 1.3-4 g/d LC n-3 PUFA may be prescribed to ↓ TG and LDL cholesterol and ↑ HDL levels		
	5D (PD)	4.3.4 reasonable to consider prescribing 1.3-4 g/d LC n-3 PUFA to improve lipid profile	O	
	3-5	4.3.5 suggest prescribing ~2 g/d LC n-3 PUFA to ↓ serum TG	2C	

GUIDELINE 4: NUTRITIONAL SUPPLEMENTATION (cont.)

Guideline Topic	CKD Stage	Guideline Statement	GRADE	Rationale
LC n-3 PUFA Nutritional Supplements: AV Graft and Fistula Patency				
	5D (MHD)	4.3.6 suggest not routinely prescribing fish oil to improve primary patency rates in patients with AV grafts or fistulas	2B 2A	
LC n-3 PUFA Nutritional Supplements: Kidney Allograft Survival				
	Posttransplantation with kidney allograft	4.3.7 suggest not routinely prescribing LC n-3 PUFA to reduce the number of rejection episodes or improve graft survival	2D	

GUIDELINE 5: MICRONUTRIENTS

Guideline Topic	CKD Stage	Guideline Statement	GRADE	Rationale
5.0 General Guidance				
Dietary Intake	3-5D, posttransplantation	5.0.1 reasonable to encourage eating a diet that meets RDA for AI of all vitamins and minerals	O	RDN or international equivalent
Assessment and Supplementation	3-5D, posttransplantation	5.0.2 reasonable to assess dietary vitamin intake periodically and to consider MVT supplementation if vitamin intake is inadequate	O	RDN or international equivalent in collaboration with a physician (PA/NP)
Supplementation, Dialysis	5D	5.0.3 in those who exhibit inadequate dietary intake for a sustained time it is reasonable to consider MVT supplementation including water-soluble and essential trace elements to prevent or treat micronutrient deficiencies	O	
5.1 Folic Acid				
Folic Acid Supplementation for Hyperhomocysteinemia	3-5D, posttransplantation	5.1.1 for those with elevated CKD associated homocysteine recommend to not routinely supplement FA with or without B complex	1A	No evidence demonstrating reduction in adverse CV outcomes
Folic Acid Supplementation for Deficiency or Insufficiency	1-5D Posttransplantation	5.1.2 suggest prescribing folate, B12, and/or B-complex supplement to correct for deficiency/ insufficiency based on clinical signs/symptoms	2B O	

GUIDELINE 5: MICRONUTRIENTS (cont.)

Guideline Topic	CKD Stage	Guideline Statement	GRADE	Rationale
5.2 Vitamin C				
Vitamin C Supplementation	1-5D, posttransplantation	5.2.1 for those at risk of vitamin C deficiency, reasonable to consider supplementation to meet recommended intake of at least 90 mg/d for men and 75 mg/d for women	O	
5.3 Vitamin D				
Supplementation for Deficiency or Insufficiency	1-5D Posttransplantation	5.3.1 suggest prescribing vitamin D supplementation as cholecalciferol or ergocalciferol to correct 25(OH)D deficiency/insufficiency	2C O	
Supplementation With Proteinuria	1-5, nephrotic proteinuria	5.3.2 reasonable to consider supplementation of cholecalciferol, ergocalciferol, or other safe and effective 25(OH)D precursors	O	
5.4 Vitamins A and E				
Supplementation and Toxicity	5D (MHD, PD)	5.4.1 reasonable to not routinely supplement vitamin A or E because of possible toxicity. If warranted, use caution to avoid excessive doses and monitor for toxicity	O	

GUIDELINE 5: MICRONUTRIENTS (cont.)

Guideline Topic	CKD Stage	Guideline Statement	GRADE	Rationale
5.5 Vitamin K				
Anticoagulant Medication and Vitamin K Supplementation	1-5D, posttransplantation	5.5.1 reasonable for those on anti-coagulants that are known to inhibit vitamin K activity (eg, warfarin) not to receive vitamin supplements	O	
5.6 Trace Minerals – Selenium and Zinc				
Selenium and Zinc Supplementation	1-5D	5.6.1 suggest not routinely supplementing selenium or zinc	2C	Little evidence that supplementation improves nutritional, inflammatory, or micronutrient status

GUIDELINE 6: ELECTROLYTES

Guideline Topic	CKD Stage	Guideline Statement	GRADE	Rationale
6.1 Acid Load				
Dietary Management of NEAP	1-4	6.1.1 suggest reducing NEAP through increased dietary intake of fruits and vegetables	2C	To reduce the rate of decline of residual kidney function
Bicarbonate Maintenance	3-5D	6.1.2 recommend reducing NEAP through increase bicarbonate or a citric acid/sodium citrate solution supplementation	1C	Same as above
	3-5D	6.1.3 reasonable to maintain serum bicarbonate levels at 24-26 mmol/L	O	
6.2 Calcium				
Total Intake	3-4	6.2.1 in those not taking active vitamin D analogs, suggest a total elemental Ca intake of 800-1000 mg/d to maintain neutral Ca balance	2B	Including dietary calcium, calcium supplementation, and calcium-based phosphate binder
	5D	6.2.2 reasonable to adjust calcium intake with consideration of concurrent use of vitamin D analogs and calcimimetics in order to avoid hypercalcemia or calcium overload	O	Same as above. Author note: dialysate calcium may affect balance

GUIDELINE 6: ELECTROLYTES (cont.)

Guideline Topic	CKD Stage	Guideline Statement	GRADE	Rationale
6.3 Phosphorus				
Amount	3-5D	6.3.1 recommend adjusting dietary P intake to maintain serum P levels in the normal range	1B	Author note: Slightly different than KDIGO Bone and Mineral Guideline
Source	1-5D, posttransplantation	6.3.2 reasonable when making decisions about P restriction treatment to consider the bioavailability of P sources	O	P sources include animal, vegetable, and additives; each have different bioavailability
Hypophosphatemia	posttransplantation	6.3.3 reasonable to consider prescribing high P intake (diet or supplements) to replace serum P	O	Due to increased phosphate excretion by the kidneys
6.4 Potassium				
Dietary Amount	3-5D, posttransplantation	6.4.1 reasonable to adjust dietary potassium intake to maintain serum K^+ within the normal range	O	
Dietary and Supplemental Intake for Hyperkalemia or Hypokalemia	3-5D	6.4.2 in those with either hyperkalemia or hypokalemia, suggest dietary or supplemental potassium intake based on individual needs and clinician judgement	2D	
	Posttransplantation	Same as above	O	

GUIDELINE 6: ELECTROLYTES (cont.)

Guideline Topic	CKD Stage	Guideline Statement	GRADE	Rationale
6.5 Sodium				
Intake and BP	3-5	6.5.1 recommended limiting Na intake to <100 mmol/d (or <2.3 g/d)	1B	To reduce BP and volume control
	5D, posttransplantation	Same as above	1C	Same as above
Intake and Proteinuria	3-5	6.5.2 suggest limiting Na intake to <100 mmol/d (or <2.3 g/d)	2A	To reduce proteinuria synergistically with available pharmacologic interventions
Intake and Dry BW	3-5D	6.5.3 suggest reduced sodium intake as an adjunctive lifestyle modification strategy	2B	To achieve better volume control and a more desirable BW

Summary of Differences Between 2000 Guidelines and 2020 Guidelines

KDOQI Nutrition Guidelines 2000	Updated KDOQI-Academy of Nutrition and Dietetics Guidelines 2020
Primarily addresses maintenance dialysis and advanced CKD without dialysis	Addresses CKD stages 1-5 including dialysis and posttransplantation
Stated "Evidence" or "Opinion" using Agency for Health Care Research and Quality (AHCRQ) guidelines	Use of highly regarded GRADE system for evaluating the evidence
Evaluation of nutrition status	More comprehensive and more evidence-based statements; more definitive recommendations for specific measures in different stages of CKD
Management of protein/energy status	More comprehensive and more evidence-based statements
Heavily focused on macronutrients	Includes macronutrients, micronutrients, electrolytes Micronutrients including intake, assessment, supplementation
	Pertinent dietary patterns are addressed
Included pediatric recommendations	Pediatric guidelines were separated from adult guidelines and updated in 2008
Nutritional counseling/follow-up	MNT, more comprehensive and more evidence-based statements
Carnitine	Not reviewed
Appendices to define measures, calculations, methodologies	Studies reviewed with citations of studies used for various measures, calculations
Literature from 1966 to 1997	Literature from 1985 to 2016 (Some earlier publications were cited in the final document as appropriate.)

Assessment