



## Complete Summary

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### GUIDELINE TITLE

Clinical practice guidelines for nutrition in chronic renal failure.

### BIBLIOGRAPHIC SOURCE(S)

Clinical practice guidelines for nutrition in chronic renal failure. K/DOQI, National Kidney Foundation. Am J Kidney Dis 2000 Jun; 35(6 Suppl 2):S1-140. [428 references]

## COMPLETE SUMMARY CONTENT

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## SCOPE

### DISEASE/CONDITION(S)

- Protein-energy malnutrition
- Chronic renal failure (CRF)

### GUIDELINE CATEGORY

Diagnosis  
Evaluation  
Management  
Risk Assessment  
Treatment

### CLINICAL SPECIALTY

Internal Medicine  
Nephrology  
Nutrition

### INTENDED USERS

Advanced Practice Nurses  
Allied Health Personnel  
Clinical Laboratory Personnel  
Dietitians  
Health Care Providers  
Health Plans  
Managed Care Organizations  
Nurses  
Physician Assistants  
Physicians

#### GUIDELINE OBJECTIVE(S)

- To improve patient survival, reduce patient morbidity, improve the quality of life of dialysis patients, and increase efficiency of care
- To address the following questions:
  - Which of the specific measures (listed in the guideline document) of nutritional status best predict patient morbidity/mortality (and growth rate in children) in maintenance dialysis patients?
  - Which of the specific measures (listed in the guideline document) is the best diagnostic test for protein/energy nutritional status in maintenance dialysis patients?
  - What is the effect of acid/base status on nutritional measures in maintenance dialysis patients?
  - Which levels of intake of protein and energy in maintenance dialysis patients produce the lowest morbidity/mortality, the most optimum changes in nutritional status using measures from Question 1 above, positive nitrogen balance, and the most optimal growth in children?
  - Which levels of protein and energy intake in predialysis patients produce the lowest morbidity at the initiation of dialysis?
  - What is the energy expenditure of maintenance dialysis patients during resting and other activities, and how does it compare with energy expenditure in normal individuals?
  - Is interdialytic weight gain a good measure for dietary compliance or a good prognostic indicator?
  - Does carnitine supplementation in adult maintenance dialysis patients improve morbidity or mortality?
  - What are the toxic/adverse effects of L-carnitine, if any, in adult maintenance dialysis patients?
  - Which nutritional interventions produce the lowest morbidity/mortality (and best growth in children) or the most optimum changes in nutritional status in maintenance dialysis patients using measures from Question 1 above?
  - Does growth hormone therapy improve growth or morbidity/mortality in pediatric maintenance dialysis patients?
  - Does vitamin or mineral supplementation (exclusive of calcium, magnesium, and vitamin D) improve morbidity/mortality in pediatric maintenance dialysis patients?

#### TARGET POPULATION

Adults and children with chronic renal failure and those undergoing maintenance dialysis therapy.

These guidelines are not intended for the nondialyzed pediatric patients with advanced chronic renal failure.

## INTERVENTIONS AND PRACTICES CONSIDERED

Assessment of protein-energy nutritional status in adult maintenance dialysis patients, including measures of:

1. Energy and protein intake
2. Visceral protein pools
3. Anthropometric measurements, such as percent usual body weight, percent standard (NHANES 11) body weight, body mass index, skin fold thickness, estimated percent body fat, and mid-arm muscle area, circumference, or diameter.
4. Functional status
5. Predialysis and stabilized serum albumen
6. Subjective global nutritional assessment
7. Dietary interviews and diaries
8. Protein equivalent of total nitrogen appearance
9. Protein catabolic rate
10. Predialysis and stabilized serum prealbumin
11. Serum creatinine and creatinine index
12. Serum cholesterol (in maintenance hemodialysis patients)
13. Dual energy x-ray absorptiometry
14. Adjusted edema-free body weight
15. Serum bicarbonate

Adult treatment considerations, including:

1. Maintenance of predialysis or stabilized serum bicarbonate levels
2. Dietary protein intake
3. Daily energy intake
4. Intensive nutritional counseling
5. Nutritional support, such as oral nutrition, tube feeding, intradialytic parenteral nutrition, or intraperitoneal amino acids
6. L-carnitine
7. Renal replacement therapy

Assessment of protein-energy nutritional status in adult chronic renal failure (CRF) patients without dialysis, including measures of:

1. Serum albumin
2. Actual or percent standard body weight and/or subjective global assessment
3. Dietary interviews and diaries/ or normalized protein equivalent of nitrogen appearance
4. Low protein diet
5. Daily energy intake

Assessment of protein-energy nutritional status in pediatric MD patients, including:

1. Dietary interview
2. Serum albumin measures
3. Height or length
4. Estimated dry weight
5. Weight/height index
6. Mid-arm circumference and muscle circumference or area
7. Skin fold thickness
8. Head circumference (3 years or less)
9. Standard deviation score (SDS or Z score) for height

Management and treatment of pediatric patients:

1. Oral administration of alkali therapy and/or the use of sodium bicarbonate dialysate solution
2. Urea kinetic modeling
3. Scheduled interval measurements of growth and nutrition parameters
4. Energy intake for children
5. Protein intake in children
6. Vitamin and mineral requirements, including thiamin (B1), riboflavin (B2), pyridoxine (B6), vitamin B12, folic acid, vitamins A, C, E, and K, copper, and zinc.
7. Nutritional counseling of patient and appropriate family member or caretaker
8. Nutritional supplementation, including oral supplementation and enteral tube feeding
9. Recombinant human growth hormone

#### MAJOR OUTCOMES CONSIDERED

- Morbidity and mortality associated with maintenance hemodialysis and chronic peritoneal dialysis
- Growth rate in children
- Nutritional status, using protein/energy measures

## METHODOLOGY

#### METHODS USED TO COLLECT/SELECT EVIDENCE

Hand-searches of Published Literature (Primary Sources)  
Searches of Electronic Databases

#### DESCRIPTION OF METHODS USED TO COLLECT/SELECT THE EVIDENCE

A structured database search of two computerized bibliographic databases (MEDLINE and EMBASE) was performed with the following specifications: Language: English and non-English articles; Dates: 1966 through 1997; Subjects: human; Article Types: letters, editorials, reviews, case reports, and abstracts of meeting proceedings were excluded. The literature search was performed in collaboration with a librarian experienced in searching computerized bibliographic

databases and performing "evidence-based" systematic reviews. The publication "Journal of Renal Nutrition" was hand-searched, because, at the time, it was not indexed in the bibliographic databases listed above. Additional referrals from the DOQI (Dialysis Outcomes Quality Initiative) Work Group members through August 1999 were reviewed.

#### NUMBER OF SOURCE DOCUMENTS

- Total articles identified (searches, later additions): 24,487
- Total abstracts reviewed: 2,125
- Total articles abstracted: 971
- Total articles that underwent structured review with evidence tables: 331
- Total final articles accepted meeting inclusion criteria: 250

#### METHODS USED TO ASSESS THE QUALITY AND STRENGTH OF THE EVIDENCE

Weighting According to a Rating Scheme (Scheme Given)

#### RATING SCHEME FOR THE STRENGTH OF THE EVIDENCE

Critical Appraisal Method for Articles Concerning Prognosis. For each prognostic article, the following characteristics were ascertained: (1) the study type; (2) the three main co-morbid conditions; (3) whether there was a representative and well-defined sample of patients at a similar phase in the course of disease; (4) the characteristics of the study population and dialysis procedures that might have affected the study results; (5) the duration of the follow-up period; (6) whether the outcomes were objective and the interpretation of the outcomes was unbiased; (7) whether adjustment was made for important known prognostic factors; and (8) the results of the study.

Critical Appraisal Methods for Articles Concerning Nutritional Assessment. For each article concerning nutritional assessment, the following information was obtained: (1) the type of study; (2) the three main co-morbid conditions; (3) whether there was an independent blinded comparison with a reference (gold) standard; (4) the characteristics of the study population and the dialysis procedures that might have affected the study results; (5) whether the results of the nutritional measure that was studied influenced the decision to measure the reference standard; (6) whether characteristics and variety of the patients' standard is similar to those found in dialysis centers; (7) whether the test methodology are described well enough to be reproducible; and (8) the results of the study.

Critical Appraisal Methods for Articles Concerning Nutritional Treatment. For each treatment article, the following information was obtained: (1) the type of study; (2) the three main co-morbid conditions; (3) the Jadad quality scores; (4) the randomization score; (5) the double blind score; (6) the score for whether all patients were accounted for; (7) an intention-to-treat score; (8) whether the treatment groups were similar at baseline; (9) the characteristics of the study population, dialysis procedure, and other ancillary treatment that might have affected the study results; (10) whether the treatment groups were treated similarly except for the study intervention; and (11) the results of the study.

The Jadad quality scores address issues most important in demonstrating the validity of randomized clinical trials and have been demonstrated to reflect methodological quality. Empirical evidence demonstrates that when these quality features are not met in clinical trials, bias and an exaggeration of the effect sizes often result.

## METHODS USED TO ANALYZE THE EVIDENCE

Systematic Review with Evidence Tables

## DESCRIPTION OF THE METHODS USED TO ANALYZE THE EVIDENCE

After loading articles from MEDLINE, EMBASE, Work Group referrals, and the Sigma Tau bibliography into an electronic database, one reviewer performed an initial title review of these articles. Two independent reviewers then reviewed the abstracts of articles whose titles were selected. Selection disagreements were resolved by consensus. English language articles for which the abstracts were selected were then obtained and categorized based on the clinical question the article addressed. Two independent reviewers then reviewed these articles. Information was abstracted from the articles by one abstracter and verified by a second. Disagreements were resolved by consensus. Articles that were rejected at this stage were coded using the following codes:

R1: Editorial, letter, review, case report, article published as abstracts

R2: Article does not answer clinical question of interest

R3: Article does not have study design of interest

R4: Pediatric article (if adult section)

R5: Not human

R6: Adult article (if pediatric section)

In order to increase precision and reduce systematic errors, the language of manuscripts was not limited to English. The English titles and English abstracts of foreign language articles, when available, were sent to all Work Group members for review. The abstracts of foreign language manuscripts were translated into English if any Work Group member thought that the paper might contribute positively to the evidence base. Selections were further based on study design. For prognostic articles, only those with prospective cohort or historical prospective cohort designs were included for further analysis. For assessment of nutritional status, only manuscripts in which a nutritional parameter was compared to a recognized standard nutritional measure or to a clinical outcome were included for further analysis. For manuscripts examining nutritional treatment, only those with a prospective design with concurrent controls were analyzed further. Because there were smaller numbers of these types of studies for carnitine treatment or pediatric renal nutrition, these requirements were not as rigidly applied for this literature.

After article abstraction, evidence tables were produced from a subset of abstracted data elements and evaluated by the Work Group during meetings in Los Angeles in August 1998 (Adult Work Group), in October 1998 (Pediatric Work Group), and during a series of subsequent conference calls. The Work Group accepted or rejected articles based on the study design and methods and the adequacy with which it addressed the clinical questions. The final selected articles are indicated by an asterisk in the reference section. Other citations, that are not asterisked, were not used for guideline development, but were used to more fully explain the background or rationale for a guideline.

## METHODS USED TO FORMULATE THE RECOMMENDATIONS

Expert Consensus (Nominal Group Technique)

## DESCRIPTION OF METHODS USED TO FORMULATE THE RECOMMENDATIONS

The group process used to develop the guidelines is a modification of the RAND/University of California, Los Angeles (UCLA) Appropriateness Method. This group process method has the following essential features: multidisciplinary, iterative, quantitative, and each panelist has equal weight in determining the final result.

In conjunction with the Work Groups, RAND and Cedars-Sinai staff developed draft guidelines based on the results of the systematic review. The draft guidelines corresponded to the key questions developed by each Work Group. The draft guidelines included all possible topics articulated by the Work Groups during the targeting phase and at the Work Group meetings to discuss the evidence. These draft guidelines were then transmitted to the Work Group members, who used the evidence tables and their expert judgment to rate each guideline statement for validity on a 1-to-9 scale. The RAND staff then compiled summaries for the face-to-face meetings of the Work Groups. At these meetings, Work Group members were provided with the summaries of these first round ratings of validity. These summary ratings were used to key a point-by-point discussion of the evidence and opinion surrounding each potential guideline statement. After each discussion, the Work Group members privately re-rated each guideline statement for validity. These votes form the basis for the final guidelines. Statements were accepted as valid if the median panel rating on validity was 7 or greater on the 1-to-9 scale. "Complete agreement" was defined as occurring when all Work Group members rated a guideline statement within the same three-point range of the scale (for example, all members' ratings were in the range of 7, 8, or 9). After determining the final guideline statements, Work Group members went through a similar two-step rating process to assess the level of evidence. A rating of "Evidence" was defined as "mainly convincing scientific evidence, limited added opinion"; "Opinion" was defined as "mainly opinion, limited scientific evidence"; and "Evidence plus Opinion" was defined as "about equal mixtures of scientific evidence and opinion."

## RATING SCHEME FOR THE STRENGTH OF THE RECOMMENDATIONS

- A rating of "evidence" was defined as "mainly convincing scientific evidence, limited added opinion";

- "Opinion" was defined as "mainly opinion, limited scientific evidence";
- "Evidence plus Opinion" was defined as "about equal mixtures of scientific evidence and opinion."

## COST ANALYSIS

A formal cost analysis was not performed and published cost analyses were not reviewed.

## METHOD OF GUIDELINE VALIDATION

External Peer Review

Internal Peer Review

## DESCRIPTION OF METHOD OF GUIDELINE VALIDATION

The purpose of the peer review process was to identify:

- Unclear wording in the draft guidelines.
- Substantive concerns regarding the content of specific guidelines.
- Important but uncited data relevant to specific draft guidelines.
- Guidelines that may be difficult to implement or that would benefit from specific strategies to facilitate compliance such as educational programs, tools, etc.

The nutrition guidelines were subjected to a three-stage peer review process:

Stage One: Primary Review.

NKF-DOQI's (National Kidney Foundation-Dialysis Outcomes Quality Initiative) multidisciplinary Steering Committee was assigned to review the draft report. Drafts were distributed to the committee in August 1999 and members had the opportunity to offer oral comments at a face-to-face meeting in mid-September. The draft report was also sent to the NKF-DOQI advisory Council, the NKF Scientific Advisory Board, and selected experts in the field. Many substantive comments were received, and this resulted in substantive changes in the organization and content of some of the guidelines and rationales. Given the large volume of comments received, the Work Group vice-chairs reviewed the comments first and entered them into a computer database separating these according to whether they had a potential minor substantive impact. Comments were sorted by guideline topic and then provided to the Work Groups for analysis and response.

Stage Two: Organizational Review.

Close to 200 individuals representing nearly 50 end-stage renal disease (ESRD)-related organizations reviewed the second draft of the guidelines in December 1999. Organizations that were invited to participate in the second round of peer review were selected by the Steering Committee based on suggestions from the Advisory Council and the Work Groups. Organizations included: various nephrology professional societies (e.g., Renal Physicians Association, American

Nephrology Nurses Association, and American Renal Administrators Association), the American Association of Kidney Patients, the ESRD Networks, NKF Councils, dialysis chains, managed care organizations, and private industry organizations selected their own reviewers.

Stage Three: Open Review.

In the final round of review, in December 1999, approximately 400 individuals received copies of the revise draft guidelines. Within 3 weeks, 30% of these reviewers provided comments. The Work Group vice-chairs sorted and organized these comments and the Work Group analyzed the responses.

Final Review of Guidelines

The Work Group and staff performed several tasks to complete the guidelines. The guidelines were edited to ensure clarity and consistency. The Work Group carefully reviewed the final draft and made the indicated changes. Accuracy of the literature citations for each guideline document was also verified.

## RECOMMENDATIONS

### MAJOR RECOMMENDATIONS

The level of evidence (Evidence, Opinion, Evidence and Opinion) for each recommendation is defined at the end of the Major Recommendations.

#### I. Adult Guidelines

##### A. Maintenance dialysis

##### 1. Evaluation of protein-energy nutritional status

###### Guideline 1. Use of panels of nutritional measures

Nutritional status in maintenance dialysis patients should be assessed with a combination of valid, complementary measures rather than any single measure alone. (Opinion)

- There is no single measure that provides a comprehensive indication of protein-energy nutritional status.
- Measures of energy and protein intake, visceral protein pools, muscle mass, other dimensions of body composition, and functional status identify different aspects of protein-energy nutritional status.
- Malnutrition may be identified with greater sensitivity and specificity using a combination of factors.

###### Guideline 2. Panels of nutritional measures for maintenance dialysis patients

For maintenance dialysis patients, nutritional status should be routinely assessed by predialysis or stabilized\* serum albumin, percent of usual body weight, percent of standard (National Health and Nutrition Evaluation Survey [NHANES] II) body weight, subjective global assessment, dietary interviews and diaries, and protein equivalent of total nitrogen appearance normalized to body weight. (Opinion)

- These parameters should be measured routinely (as indicated in Table 1) because they provide a valid and clinically useful characterization of the protein-energy nutritional status of maintenance dialysis patients.

\* a predialysis serum measurement is obtained from an individual immediately before the initiation of a hemodialysis or intermittent peritoneal dialysis treatment. A stabilized serum measurement is obtained after the patient has stabilized on a given dose of continuous ambulatory peritoneal dialysis.

Table 1. Recommended Measures for Monitoring Nutritional Status of Maintenance Dialysis Patients

| Category   | Measure  |
|--|--|
| V. Measurements that should be performed routinely in all patients | <ul style="list-style-type: none"> <li>• Predialysis stabilized serum albumin</li> <li>• Percent of postdialysis (maintenance hemodialysis) or post-drain (continuous ambulatory peritoneal dialysis) body weight</li> <li>• Percent of standard (NHANES II) body weight</li> <li>• Subjective global assessment</li> <li>• Dietary interviews and/or diaries</li> </ul> |

- Protein eq  
of total nitrogen appearance  
normalized to body weight
  
- II. Measures that can be useful to confirm or extend the data obtained from the measures in Category I
  - Predialysis stabilized serum pre-albumin
  - Skinfold thickness
  - Mid-arm muscle area, circumference, or diameter
  - Dual energy absorptiometry
  
- III. Clinically useful measures, which, if low, might suggest the need for a more rigorous examination of protein-energy nutritional status
  - Predialysis stabilized serum
    - Creatinine
    - Urea nitrogen
    - Cholesterol
  - Creatinine

Guideline 3. Serum albumin

Serum albumin is a valid and clinically useful measure of protein-energy nutritional status in maintenance dialysis patients. (Evidence)

- The predialysis or stabilized serum albumin is a measure of visceral protein pool size.
- The serum albumin at the time of initiation of chronic dialysis therapy or during the course of maintenance dialysis is an indicator of future mortality risk.
- A predialysis or stabilized serum albumin equal to or greater than the lower limit of the normal range (approximately 4.0 g/dL for the bromocresol green method) is the outcome goal.
- Individuals with a predialysis or stabilized serum albumin that is low should be evaluated for protein-energy malnutrition.
- The presence of acute or chronic inflammation limits the specificity of serum albumin as a nutritional marker.

#### Guideline 4. Serum prealbumin

Serum prealbumin is a valid and clinically useful measure of protein-energy nutritional status in maintenance dialysis patients. (Evidence and Opinion)

- The predialysis or stabilized serum prealbumin is a measure of visceral protein pool size.
- The serum prealbumin level at the time of initiation of dialysis or during maintenance dialysis is an indicator of future mortality risk.
- An individual with predialysis or stabilized serum prealbumin less than 30 mg/dL should be evaluated for protein-energy malnutrition.
- The presence of acute or chronic inflammation limits the specificity of serum prealbumin a nutritional marker.
- There is insufficient evidence to conclude that prealbumin is a more sensitive index of nutritional status than albumin.

#### Guideline 5. Serum creatinine and the creatinine index

The serum creatinine and creatinine index are valid and clinically useful markers of protein-energy nutritional status in maintenance dialysis patients. (Evidence and Opinion)

- The predialysis or stabilized serum creatinine and the creatinine index reflect the sum of dietary intake of foods rich in creatine and creatinine (eg, skeletal muscle) and endogenous (skeletal muscle) creatinine production minus the urinary excretion, dialytic removal, and endogenous degradation of creatinine.
- Individuals with low predialysis or stabilized serum creatinine (less than approximately 10 mg/dL) should be evaluated for protein-energy malnutrition and wasting of skeletal muscle.

- A low creatinine index and, in the absence of substantial endogenous urinary creatinine clearance, a low serum creatinine concentration suggest low dietary protein intake and/or diminished skeletal muscle mass and are associated with increased mortality rates.

#### Guideline 6. Serum cholesterol

Serum cholesterol is a valid and clinically useful marker of protein-energy nutritional status in maintenance hemodialysis patients. (Evidence and Opinion)

- Low or declining serum cholesterol concentrations are predictive of increased mortality risk.
- Hypocholesterolemia is associated with chronic protein-energy deficits and/or the presence of comorbid conditions, including inflammation.
- Individuals with low, low-normal (less than approximately 150 to 180 mg/dL), or declining serum cholesterol levels should be investigated for possible nutritional deficits.

#### Guideline 7. 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)

#### Guideline 8. Protein equivalent of total nitrogen appearance

Protein equivalent of total nitrogen appearance or protein catabolic rate is a valid and clinically useful measure of net protein degradation and protein intake in maintenance dialysis patients. (Evidence)

- When nitrogen balance is zero in the steady state, the difference between nitrogen intake and total nitrogen losses is zero or only slightly positive (ie, up to about 0.5 g nitrogen/d because of unmeasured nitrogen losses). Hence, in the clinically stable patient, protein equivalent of total nitrogen appearance provides a valid estimate of protein intake.
- The protein equivalent of total nitrogen appearance can be estimated from interdialytic changes in urea nitrogen concentration in serum and the urea nitrogen content of urine and dialysate.
- Because both net protein breakdown under fasting conditions and dietary protein requirements are strongly influenced by body mass, protein equivalent of total nitrogen appearance (or protein catabolic rate) is often normalized to a function of body weight (Guideline 12).

### Guideline 9. Subjective global nutritional assessment

Subjective global assessment is a valid and clinically useful measure of protein-energy nutritional status in maintenance dialysis patients. (Evidence)

### Guideline 10. Anthropometry

Anthropometric measurements are valid and clinically useful indicators of protein-energy nutritional status in maintenance dialysis patients. (Evidence and Opinion)

- These measures include percent usual body weight, percent standard body weight, body mass index, skinfold thickness, estimated percent body fat, and mid-arm muscle area, circumference, or diameter.

### Guideline 11. Dual energy x-ray absorptiometry

Dual energy x-ray absorptiometry 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 dual energy x-ray absorptiometry provides an accurate method to assess body composition which is less influenced by the abnormalities in hydration status common in maintenance dialysis patients.

### Guideline 12. Adjusted edema-free body weight

The body weight to be used for assessing or prescribing protein or energy intake is the adjusted edema-free body weight. For hemodialysis patients, this should be obtained postdialysis. For peritoneal dialysis patients, this should be obtained after drainage of dialysate. (Opinion)

- The adjusted edema-free body weight should be used for maintenance dialysis patients who have an edema-free body weight less than 95% or greater than 115% of the median standard weight, as determined from the NHANES II data.
- For individuals whose edema-free body weight is between 95% and 115% of the median standard weight, the actual edema-free body weight may be used.
- For dual energy x-ray absorptiometry measurements of total body fat and fat-free mass, the actual edema-free body weight obtained at the time of the dual energy x-ray absorptiometry measurement should be used.

- For anthropometric calculations, the postdialysis (for maintenance hemodialysis) or postdrain (for continuous peritoneal dialysis) actual edema-free body weight should be used.
2. Management of acid-base status

Guideline 13. Measurement of serum bicarbonate

Serum bicarbonate should be measured in maintenance dialysis patients once monthly. (Opinion)

Guideline 14. Treatment of low serum bicarbonate

Predialysis or stabilized serum bicarbonate levels should be maintained at or above 22 mmol/L. (Evidence and Opinion)

3. Management of protein and energy intake

Guideline 15. Dietary protein intake in maintenance hemodialysis

The recommended dietary protein intake for clinically stable maintenance hemodialysis 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.

Guideline 16. Dietary protein intake for chronic peritoneal dialysis

The recommended dietary protein intake for clinically stable chronic peritoneal dialysis 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.

Guideline 17. Daily energy intake for maintenance dialysis patients

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 expenditure of patients undergoing maintenance hemodialysis or continuous ambulatory peritoneal dialysis is similar to that of normal, healthy individuals.
  - Metabolic balance studies of people undergoing maintenance hemodialysis indicate that a total daily energy intake of about 35 kcal/kg/d induces neutral nitrogen balance and is adequate to maintain serum albumin and anthropometric indices.
  - Because individuals more than 60 years of age tend to be more sedentary, a total energy intake of 30 to 35 kcal/kg is acceptable.
2. Nutritional counseling and follow-up

Guideline 18. Intensive nutritional counseling with maintenance dialysis

Every maintenance dialysis patient should receive intensive nutritional counseling based on an individualized plan of care developed before or at the time of commencement of maintenance dialysis 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.

Guideline 19. 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 (for hemodialysis) or intraperitoneal amino acids (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 intradialytic parenteral nutrition or intraperitoneal amino acids 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.

#### Guideline 20. 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.

#### Guideline 21. Energy intake during acute illness

The recommended energy intake for a maintenance dialysis patient who is acutely ill is at least 35 kcal/kg/d for those who are less than 60 years of age and at least 30 to 35 kcal/kg/d for those who are 60 years of age or older. (Evidence and Opinion)

### 3. Carnitine

#### Guideline 22. L-carnitine for maintenance dialysis patients

There are insufficient data to support the routine use of L-carnitine for maintenance dialysis patients. (Evidence and Opinion)

- Although the administration of L-carnitine may improve subjective symptoms such as malaise, muscle weakness, intradialytic cramps and hypotension, and quality of life in selected maintenance dialysis patients, the totality of evidence is insufficient to recommend its routine

- provision for any proposed clinical disorder without prior evaluation and attempts at standard therapy
  - The most promising of proposed applications is treatment of erythropoietin-resistant anemia.
- B. Advanced chronic renal failure without dialysis

Guideline 23. Panels of nutritional measures for nondialyzed patients

For individuals with chronic renal failure (glomerular filtration rate <20 mL/min) protein-energy nutritional status should be evaluated by serial measurements of a panel of markers including at least one value from each of the following clusters: (1) serum albumin; (2) edema-free actual body weight, percent standard (NHANES II) body weight, or subjective global assessment; and (3) normalized protein nitrogen appearance or dietary interviews and diaries. (Evidence and Opinion)

- It is recommended that serum albumin and actual or percent standard body weight and/or subjective global assessment be measured every 1 to 3 months.
- Dietary interviews and diaries and/or protein equivalent of total nitrogen appearance normalized to body weight should be performed every 3 to 4 months.
- For patients with more advanced chronic renal failure (ie, glomerular filtration rate  $\leq$ 15 mL/min), concomitant illness, inadequate nutrient intake, deteriorating nutritional status, or frank malnutrition, more frequent monitoring may be necessary.

Guideline 24. Dietary protein intake for nondialyzed patients

For individuals with chronic renal failure (glomerular filtration rate <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 dietary energy intake with such a diet, an intake of up to 0.75 g protein/kg/d may be prescribed. (Evidence and Opinion)

- When properly implemented and monitored, low-protein, high-energy diets maintain nutritional status while limiting the generation of potentially toxic nitrogenous metabolites, the development of uremic symptoms, and the occurrence of other metabolic complications.
- Evidence suggests that low protein diets may retard the progression of renal failure or delay the need for dialysis therapy.
- At least 50% of the dietary protein should be of high biologic value.

- When patients with chronic renal failure consume uncontrolled diets, a decline in protein intake and in indices of nutritional status is often observed.

#### Guideline 25. Dietary energy intake for nondialyzed patients

The recommended dietary energy intake 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)

- Energy expenditure of nondialyzed individuals with chronic renal failure is similar to that of healthy individuals.
- Metabolic balance studies of such individuals indicate that a diet providing about 35 kcal/kg/d engenders neutral nitrogen balance and maintains serum albumin and anthropometric indices.
- Because individuals more than 60 years of age tend to be more sedentary, a lower total energy intake of 30 to 35 kcal/kg/d is acceptable.

#### Guideline 26. Intensive nutritional counseling for chronic renal failure

The nutritional status of individuals with chronic renal failure should be monitored at regular intervals. (Evidence)

- A spontaneous reduction in dietary protein intake and a progressive decline in indices of nutritional status occur in many nondialyzed patients with chronic renal failure.
- The presence of protein-energy malnutrition at the initiation of maintenance dialysis is predictive of future mortality risk.
- Interventions that maintain or improve nutritional status during progressive renal failure are likely to be associated with improved long-term survival after commencement of maintenance dialysis.
- Because evidence of protein-energy malnutrition may develop before individuals require renal replacement therapy, regular monitoring (eg, at 1-to 3-month intervals) of the patient's nutritional status should be a routine component of the care for the patient with chronic renal failure.
- Nutritional status should be assessed more frequently if there is inadequate nutrient intake, frank protein-energy malnutrition, or the presence of an illness that may worsen nutritional status.

#### Guideline 27. Indications for renal replacement therapy

In patients with chronic renal failure (e.g., glomerular filtration rate <15 to 20 mL/min) who are not undergoing maintenance dialysis, if protein-energy malnutrition develops or persists despite vigorous attempts to optimize protein and energy

intake and there is no apparent cause for malnutrition other than low nutrient intake, initiation of maintenance dialysis or a renal transplant is recommended. (Opinion)

## II. Pediatric Guidelines

### Guideline 1. Patient evaluation of protein-energy nutritional status

The most valid measures of protein and energy nutrition status in children treated with maintenance dialysis include: (Evidence and Opinion)

- Dietary interview/diary (Opinion)
- Serum albumin (Opinion)
- Height or length (Evidence and Opinion)
- Estimated dry weight (Evidence and Opinion)
- Weight/height index (Opinion)
- Mid-arm circumference and muscle circumference or area (Opinion)
- Skinfold thickness (Opinion)
- Head circumference (3 years or less) (Evidence and Opinion)
- Standard deviation score (SDS or Z score) for height (Evidence and Opinion)

### Guideline 2. Management of acid-base status

Because acidemia exerts a detrimental effect on growth and nutritional status, serum bicarbonate levels below 22 mmol/L should be corrected with oral administration of alkali therapy and/or the use of higher sodium bicarbonate dialysate solution in patients treated with maintenance hemodialysis. (Evidence and Opinion)

### Guideline 3. Urea kinetic modeling

Urea kinetic modeling may have a role in the nutritional assessment and management of children treated with maintenance dialysis. Although protein equivalent of total nitrogen appearance is useful to assess and follow nutritional status in adults, there is currently insufficient evidence to recommend its routine use in pediatric patients. (Evidence and Opinion)

### Guideline 4. Interval measurement

Scheduled, interval measurements of growth and nutrition parameters should be obtained to provide optimal care of the nutritional needs of children on maintenance peritoneal dialysis or hemodialysis. (Evidence and Opinion)

### Guideline 5. Energy intake for children treated with maintenance dialysis

The initial prescribed energy intake for children treated with maintenance hemodialysis or peritoneal dialysis should be at the

Recommended Dietary Allowance (RDA) level for chronological age. Modifications should then be made depending upon the child's response. (Evidence and Opinion)

Guideline 6. Protein intake for children treated with maintenance dialysis

Children treated with maintenance hemodialysis should have their initial dietary protein intake based on the Recommended Dietary Allowances for chronological age and an additional increment of 0.4 g/kg/d. (Evidence and Opinion)

Children treated with maintenance peritoneal dialysis should have their initial dietary protein intake based on the Recommended Dietary Allowances for their chronological age plus an additional increment based on anticipated peritoneal losses. (Evidence and Opinion)

Guideline 7. Vitamin and mineral requirements

The recommended dietary intake should achieve 100% of the Dietary Reference Intakes for thiamin (B1), riboflavin (B2), pyridoxine (B6), vitamin B12, and folic acid. An intake of 100% of the Recommended Dietary Allowance should be the goal for vitamins A, C, E, and K, copper, and zinc. (Evidence and Opinion)

Guideline 8. Nutrition management

Every dialysis patient and appropriate family member (or caretaker) should receive intensive nutrition counseling based on an individualized plan of care, which includes relevant, standardized measurements of growth and physical development, developed prior to or at the time of initiation of maintenance dialysis. (Opinion)

The nutrition plan of care developed during the early phase of maintenance dialysis therapy should be re-evaluated frequently and modified according to progress. The maximum time between such updates is 3 to 4 months. (Opinion)

Guideline 9. Nutritional supplementation for children treated with maintenance dialysis

Supplemental nutritional support should be considered when a patient is not growing normally (eg, does not have normal height velocity) or fails to consume the Recommended Dietary allowances for protein and/or energy. Supplementation by the oral route is preferred followed by enteral tube feeding. (Evidence and Opinion)

Guideline 10. Recommendations for the use of recombinant human growth hormone for children treated with maintenance dialysis

Treatment with recombinant human growth hormone in dialysis patients with growth potential should be considered under the following conditions: (Evidence and Opinion)

- Children who have (1) a height for chronological age more negative than 2.0 standard deviation scores (SDS) or (2) a height velocity for chronological age SDS more negative than 2.0 SDS, (3) growth potential documented by open epiphyses, and (4) no other contraindication for recombinant human growth hormone use.
- Prior to consideration of the use of recombinant human growth hormone, there should be correction of (1) insufficient intake of energy, protein, and other nutrients, (2) acidosis, (3) hyperphosphatemia (the level of serum phosphorus should be less than 1.5X the upper limit age), and (4) secondary hyperparathyroidism.

Definitions of level of evidence:

- A rating of "evidence" was defined as "mainly convincing scientific evidence, limited added opinion";
- "Opinion" was defined as "mainly opinion, limited scientific evidence";
- "Evidence plus Opinion" was defined as "about equal mixtures of scientific evidence and opinion."

CLINICAL ALGORITHM(S)

None provided

## EVIDENCE SUPPORTING THE RECOMMENDATIONS

TYPE OF EVIDENCE SUPPORTING THE RECOMMENDATIONS

Evidentiary Basis for Guidelines

The guidelines were developed using an evidence-based approach similar to the one used by The Federal Agency for Healthcare Research and Quality (AHRQ). That is, before formulating recommendations, the Work Groups reviewed all published evidence pertinent to the topics being considered and critically appraised the quality and strength of that evidence. For many issues that the Work Groups chose to address, there either was no pertinent literature available or available evidence was flawed or weak. As a result, in many instances the Work Groups formulated their recommendations based on the opinions of the Work Group members and comments received from the peer reviewers. In all instances, the Work Groups have documented the rationale for their recommendations. That is, they have articulated each link in the chain of logic they used as the evidentiary or opinion-related basis for their recommendation. This approach helps readers of the guidelines determine the quantity and quality of evidence underlying each recommendation.

Although some of the DOQI guidelines are cleared based entirely on evidence or entirely on opinion, many are based in part on evidence and in part on opinion.

Such "hybrid" guidelines arise when some (or even most) of the links in the chain of logic underlying a guideline are based on empirical evidence, but some (i.e., at least one) are based on opinion. The opinion of the Work Group members can enter the chain of logic that supports a guideline either to fill in a gap in available evidence on some scientific or clinical issue, or in the form of a value judgment regarding what they feel is appropriate clinical practice based on available evidence. Thus, many opinion-based guidelines may have substantial empirical evidence underlying them.

## BENEFITS/HARMS OF IMPLEMENTING THE GUIDELINE RECOMMENDATIONS

### POTENTIAL BENEFITS

Provision of adequate nutrition is a key component of the prevention and treatment of protein-energy malnutrition in adults and children receiving maintenance dialysis. Anticipated benefits include improved patient survival, reduction of patient morbidity, improved quality of life of dialysis patients, and increased efficiency of care.

### POTENTIAL HARMS

Risks of enteral feeding include pulmonary aspiration, fluid overload, reflux esophagitis, and other complications of enteral feeding devices.

- Disadvantages to intradialytic parenteral nutrition include provision of insufficient calories and protein to support long-term daily needs (i.e., intradialytic parenteral nutrition is given during dialysis for only 3 days out of 7), it does not change patient's food behavior or encourage them to eat more healthy meals, and it is expensive.
- Intraperitoneal amino acids may result in a mild metabolic acidosis.
- Reported complications associated with nasogastric and gastrostomy tubes or button feeding include emesis, exit-site infection, leakage, and peritonitis. A prolonged and potentially difficult transition from tube to oral feeding can occur in infants who use any form of enteral tube feeding.

## QUALIFYING STATEMENTS

### QUALIFYING STATEMENTS

- These guidelines are based on the best information available at the time of publication. They are designed to provide information and assist in decision-making. They are not intended to define a standard of care, and should not be construed as one. Neither should they be interpreted as prescribing an exclusive course of management. Variations in practice will inevitably and appropriately occur when clinicians take into account the needs of individual patients, available resources, and limitations unique to an institution or type of practice. Every healthcare professional making use of these guidelines is responsible for evaluating the appropriateness of applying them in the setting of any particular clinical situation.
- For logistical reasons, recommendations for the nutritional management of nondialyzed pediatric patients with advanced chronic renal failure were not

developed. The decision was made to not address vitamin and mineral needs or the use of anabolic agents in the adult maintenance dialysis patient, because the scope of the subject matter and the volume of scientific literature was considered to be too large for inclusion in this set of guidelines.

## IMPLEMENTATION OF THE GUIDELINE

### DESCRIPTION OF IMPLEMENTATION STRATEGY

The National Kidney Foundation (NKF) plans to undertake three types of activities to promote implementation of these recommendations:

- Translating recommendations into practice. K/DOQI will develop core patient and professional education programs and tools to facilitate the adoption of their recommendations.
- Building commitment to reducing practice variations. K/DOQI will work with providers and insurers to clarify the need for and the benefits of changes in practice patterns and to encourage the adoption of the guidelines.
- Evaluation. K/DOQI, in collaboration with other relevant organizations, will participate in the development of performance measures that can be used to assess compliance with the K/DOQI practice guidelines. In addition, the association between compliance with the K/DOQI guidelines and patient outcomes will be evaluated in an effort to validate and improve the guidelines over time.

## INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT CATEGORIES

### IOM CARE NEED

Living with Illness

### IOM DOMAIN

Effectiveness

## IDENTIFYING INFORMATION AND AVAILABILITY

### BIBLIOGRAPHIC SOURCE(S)

Clinical practice guidelines for nutrition in chronic renal failure. K/DOQI, National Kidney Foundation. Am J Kidney Dis 2000 Jun; 35(6 Suppl 2):S1-140. [428 references]

### ADAPTATION

Not applicable: The guideline was not adapted from another source.

### DATE RELEASED

2000 Jun

#### GUIDELINE DEVELOPER(S)

National Kidney Foundation - Disease Specific Society

#### SOURCE(S) OF FUNDING

The NKF-K/DOQI (National Kidney Foundation-Kidney Disease Outcomes Quality Initiative) nutrition guidelines are funded by an unrestricted grant from Sigma-Tau Pharmaceuticals, Inc.

#### GUIDELINE COMMITTEE

NKF-K/DOQI (National Kidney Foundation-Kidney Disease Outcomes Quality Initiative)

#### COMPOSITION OF GROUP THAT AUTHORED THE GUIDELINE

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#### FINANCIAL DISCLOSURES/CONFLICTS OF INTEREST

All Work Group members completed a disclosure statement and certified that any potential conflict of interest would not influence their judgement or actions concerning the guidelines.

#### Adult Work Group

Suhail Ahmad, BSc, MB, BS, MD, has received research grants and/or gives lectures for the following companies: Advanced Renal Technologies, Hoechst Marion Roussel, Novartis, Sigma-Tau Pharmaceuticals, Inc, Astra Zeneca, and Searle.

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#### Pediatric Work Group

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Craig B. Langman, MD, serves on the Academic Advisory Board of Total Renal Care, Inc. He has served as a consultant for many pharmaceutical laboratories, health care companies, and health care related Foundations, including Merck USA, Roche Pharmaceuticals, Abbott Laboratories, and the Oxalosis and Hyperoxaluria Foundation.

Bruce Morgenstern, MD, is currently the Principal Investigator of a multicenter study of peritoneal adequacy in children, involving the Pediatric Peritoneal Dialysis Study Consortium institutions. This study is partly funded by Baxter Healthcare.

Isidro B. Salusky, MD, FAAP, is a consultant for Genzyme, Inc, Bone Care International, and Abbott Laboratories.

Bradley A. Warady, MD, has had research funded by Baxter Health Care and Schein Pharmaceuticals.

#### GUIDELINE STATUS

This is the current release of the guideline.

An update is not in progress at this time.

#### GUIDELINE AVAILABILITY

Electronic copies: Available from the National Kidney Foundation (NKF) [Kidney Disease Outcomes Quality Initiative \(K/DOQI\) Web site](#).

Print copies: Available from the National Kidney Foundation (NKF), 30 East 33rd St., New York, NY 10016.

#### AVAILABILITY OF COMPANION DOCUMENTS

Currently under development.

#### PATIENT RESOURCES

None available

#### NGC STATUS

This summary was completed by ECRI on October 27, 2000. The information was verified by the guideline developer on December 1, 2000.

#### COPYRIGHT STATEMENT

This NGC summary is based on the original guideline, which is copyrighted by the National Kidney Foundation (NKF).

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The logo for FIRSTGOV, featuring the word "FIRST" in blue and "GOV" in red, with a small red star above the "I" in "FIRST".

