Complete Summary

GUIDELINE TITLE

NKF-KDOQI clinical practice guidelines for peritoneal dialysis adequacy: update 2006.

BIBLIOGRAPHIC SOURCE(S)

Peritoneal Dialysis Adequacy Work Group. Clinical practice guidelines for peritoneal dialysis adequacy. Am J Kidney Dis 2006 Jul;48 Suppl 1:S98-129. PubMed

GUIDELINE STATUS

This is the current release of the guideline.

This guideline updates a previous version: NKF-K/DOQI clinical practice guidelines for peritoneal dialysis adequacy: update 2000. Am J Kidney Dis 2001 Jan;37(1 Suppl 1):S65-S136.

COMPLETE SUMMARY CONTENT

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SCOPE

DISEASE/CONDITION(S)

End-stage renal disease (ESRD)

GUIDELINE CATEGORY

Management
Treatment

CLINICAL SPECIALTY

Family Practice
Internal Medicine
Nephrology
Pediatrics

INTENDED USERS

Advanced Practice Nurses
Allied Health Personnel
Clinical Laboratory Personnel
Health Care Providers
Health Plans
Nurses
Patients
Physician Assistants
Physicians
Social Workers

GUIDELINE OBJECTIVE(S)

To update the 2000 Kidney Disease Outcomes Quality Initiative (KDOQI) Clinical Practice Guidelines on Peritoneal Dialysis Adequacy

TARGET POPULATION

Adult and pediatric patients with end-stage renal disease who receive peritoneal dialysis (PD) treatment, primarily patients on continuous ambulatory PD (CAPD)

INTERVENTIONS AND PRACTICES CONSIDERED

1. Patient education about kidney failure and options for its treatment
2. Estimation of kidney function by estimation of glomerular filtration rate (GFR)
3. Optimal timing of initiation of dialysis
4. Measures of peritoneal dialysis dose and total solute clearance
5. Preservation of residual kidney function, including use of angiotensin-converting enzyme (ACE) inhibitors and angiotensin receptor blockers (ARBs) and avoiding insults to residual kidney function (RKF)
6. Maintenance of euvolemia through monthly monitoring and therapies to optimize extracellular water, blood volume, and blood pressure
7. Establishment of quality improvement programs

MAJOR OUTCOMES CONSIDERED

- Morbidity (including cardiovascular and cerebrovascular events) and mortality among end-stage renal disease patients on hemodialysis
- Survival
- Indicators of peritoneal dialysis (PD) adequacy
- Patient adherence to PD prescription
- Hospitalization

- Technique survival
- Nutrition
- Growth (pediatrics)
- Cognitive function (pediatrics)
- Blood pressure/hypertension
- Left ventricular hypertrophy (LVH)
- Quality of Life

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

Based on the draft guideline statements, the Work Group members agreed on topics that would be systematically reviewed and formulated questions defining predictors, interventions, comparators, and outcomes of interest. Search strategies were developed based on these questions and topics, in addition to the study designs and years of publications of interest to the Work Group (see Appendix 2 of the original guideline document). Articles of interest were identified through MEDLINE searches of English language literature of human studies in May through July 2004. Broad search terms were used to avoid missing potentially pertinent articles. The searches were supplemented by articles identified by Work Group members through June 2005.

Only full journal articles of original data were included. The searches were limited to studies published since January 1997 since earlier publications were reviewed in the previous Dialysis Outcomes Quality Initiatives (DOQI) guidelines. Editorials, letters, abstracts, and unpublished reports were not included. Selected review articles, however, were included for background material. No systematic process was followed to obtain review articles.

Abstracts and titles from the MEDLINE search results were prescreened by members of the Evidence Review Team for general relevance. A second round of screening was performed on the abstracts by Work Group members for relevance using predefined eligibility criteria, described below. Articles were retrieved by the Evidence Review Team and then rescreened by Work Group members and/or the Evidence Review Team. Eligible studies were extracted using standardized extraction forms. Domain experts made the final decisions regarding the eligibility of all articles.

Literature Yield

A total of 2,307 citations were screened and 7 were added by Work Group members. There were 293 articles (263 studies in adults and 30 in children) that were potentially relevant. These articles were retrieved for full review. Of these, 101 adult articles were accepted for full data extraction by the Work Group members. Nine articles in children were formally data extracted by a pediatric

nephrologist on the Work Group. Articles in adults were randomly assigned to individual Work Group members for data extraction. Of these, 27 studies answered questions pertinent to topics chosen for systematic listing in Summary Tables. See Table 4 of Appendix 1 of the original guideline document for further detail on literature yield.

Limitations of Approach

While the literature searches were intended to be comprehensive, they were not exhaustive. MEDLINE was the only database searched, and searches were limited to English language publications. Hand searches of journals were not performed, and review articles and textbook chapters were not systematically searched. However, important studies known to the domain experts that were missed by the literature search were included in the review.

Because of resource limitations and other practical considerations, there were several deviations from the original protocol for several of the update topics. These primarily resulted in nephrologists in the Evidence Review Team, rather than Work Group members, performing the primary article screening and the data extraction for articles included in several Summary Tables. However, all articles that met criteria for all topics, all completed data extraction forms, and all Summary Tables were distributed to relevant Work Group members for critical review and incorporation into guidelines.

NUMBER OF SOURCE DOCUMENTS

27

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

The quality of evidence was not explicitly graded. It was implicitly assessed according to the criteria outlined in the table below, and considered: i) the methodological quality of the studies; ii) whether or not the studies were carried out in the target population (i.e., patients on dialysis, or in other populations) and iii) whether the studies examined health outcomes directly, or examined surrogate measures for those outcomes (e.g., blood flow instead of access survival.)

		Methodological Quality		
Outcome	Population	Well designed and analyzed (little, if any, potential bias)	Some problems in design and/or analysis (some potential bias)	Poorly designed and/or analyzed (large potential bias)
Health outcome(s)	Target population	Strong[a]	Moderately Strong[b]	Weak[h]
Health outcome(s)	Other than the target	Moderately Strong[c]	Moderately Strong[d]	Weak[h]

		Methodological Quality		
	population			
Surrogate measure for health outcome(s)	Target population	Moderately Strong[e]	Weak[f]	Weak[h]
Surrogate measure for health outcome(s)	Other than the target population	Weak[g]	Weak[g]	Weak[g,h]

Definitions:

Strong: [a]Evidence includes results from well-designed, well-conducted study/studies in the target population that directly assess effects on health outcomes.

Moderately Strong: [b]Evidence is sufficient to determine effects on health outcomes in the target population, but the strength of the evidence is limited by the number, quality, or consistency of the individual studies. [c]OR evidence is from a population other than the target population, but from well-designed, well-conducted studies; [d]OR evidence is from studies with some problems in design and/or analyses.; [e]OR evidence is from well-designed, well-conducted studies or surrogate endpoints for efficacy and/or safety in the target population.

Weak: [f]Evidence is insufficient to assess the effects on net health outcomes because it is from studies with some problems in design and/or analysis on surrogate endpoints for efficacy and/or safety in the target population; [g]OR the evidence is only for surrogate measures in a population other than the target population; [h]OR the evidence is from studies that are poorly designed and/or analyzed.

METHODS USED TO ANALYZE THE EVIDENCE

Systematic Review with Evidence Tables

DESCRIPTION OF THE METHODS USED TO ANALYZE THE EVIDENCE

Generation of Data Extraction Forms

Data extraction forms were designed to capture information on various aspects of the primary articles. Forms for all topics included study setting and demographics, eligibility criteria, causes of kidney disease, numbers of subjects, study design, study funding source, dialysis characteristics, comorbid conditions, descriptions of relevant risk factors or interventions, description of outcomes, statistical methods, results, study quality (based on criteria appropriate for each study design, study applicability, and sections for comments and assessment of biases. Training of the Work Group members to extract data from primary articles occurred by emails and teleconferences. Work Group members were assigned the task of data extraction of articles.

Generation of Evidence Tables

The Evidence Review Team condensed the information from the data extraction forms into evidence tables, which summarized individual studies. These tables were created for the Work Group members to assist them with review of the evidence and are not included in the guidelines. All Work Group members received copies of all extracted articles and all evidence tables. During the development of the evidence tables, the Evidence Review Team checked the data extraction for accuracy and re-screened the accepted articles to verify that each of them met the initial screening criteria determined by the Work Group. If the criteria were not met, the article was rejected, in consultation with the Work Group.

Format for Summary Tables

Summary Tables describe the studies according to the following dimensions: study size and follow-up duration, applicability or generalizability, results, and methodological quality. Within each table, the studies are first grouped by outcome type. Data entered into Summary Tables were derived from the data extraction forms, evidence tables, and/or the articles by the Evidence Review Team. All Summary Tables were reviewed by the Work Group members.

Within each outcome, studies are ordered first by methodological quality (best to worst), then by applicability (most to least), and then by study size (largest to smallest). When relevant, outcome thresholds (e.g., of access flow measurement) are included. Results are presented by using the appropriate metric or summary symbols, as defined in the table footnotes.

Systematic Review Topics, Study Eligibility Criteria, and Studies Evaluated

The topics for each Update were selected by the respective Work Group members for systematic review (see Tables 1-3 in Appendix 1 of the original guideline document). The eligibility criteria were defined by the Work Group members of each Update in conjunction with the Evidence Review Team.

Grading of Individual Studies

Study Size and Duration

The study (sample) size is used as a measure of the weight of the evidence. In general, large studies provide more precise estimates of prevalence and associations. In addition, large studies are more likely to be generalizable; however, large size alone, does not guarantee applicability. A study that enrolled a large number of selected patients may be less generalizable than several smaller studies that included a broad spectrum of patient populations. Similarly, longer duration studies may be of better quality and more applicable, depending on other factors.

Applicability

Applicability (also known as generalizability or external validity) addresses the issue of whether the study population is sufficiently broad so that the results can be generalized to the population of interest at large. The study population is

typically defined primarily by the inclusion and exclusion criteria. The target population was defined to include patients with kidney failure, specifically those on dialysis. A designation for applicability was assigned to each article, according to a three-level scale. In making this assessment, sociodemographic characteristics were considered, as well as comorbid conditions and prior treatments. Applicability is graded in reference to the population of interest as defined in the clinical question. For example for the question of treatment of catheter-related infections the reference population is that of HD patients with infected cuffed tunneled hemodialysis (HD) catheters (see Appendix 1 of the original guideline document for details).

Results

The type of results available in each study is determined by the study design, the purpose of the study, and the question(s) being asked. The Work Group decided on the eligibility criteria and outcomes of interest (see Tables 1-3 in Appendix 1 of the original guideline document).

Diagnostic Test Studies

For studies of diagnostic tests, sensitivity and specificity data or area under the curve were included when reported. When necessary, sensitivity and specificity data were calculated from the reported data. Diagnostic tests were evaluated according to a hierarchy of diagnostic tests. Each test was assessed according to diagnostic technical capacity, accuracy, diagnostic and therapeutic impact, and patient outcome. This ultimately affected the overall strength of a recommendation regarding a diagnostic test.

Methodological Quality

Methodological quality (or internal validity) refers to the design, conduct, and reporting of the clinical study. Because studies with a variety of types of design were evaluated, a 3-level classification of study quality was devised (see Appendix 1 of the original guideline document for details).

Summarizing Reviews and Selected Original Articles

Work Group members had wide latitude in summarizing reviews and selected original articles for topics that were determined not to require a systemic review of the literature.

METHODS USED TO FORMULATE THE RECOMMENDATIONS

Expert Consensus

DESCRIPTION OF METHODS USED TO FORMULATE THE RECOMMENDATIONS

The Work Group sought to update the guidelines using an evidence-based approach. After topics and relevant clinical questions were identified for the

updates, the available scientific literature on those topics was systematically searched and summarized.

Creation of Groups

The Kidney Disease Outcomes Quality Initiative (KDOQI) Advisory Board selected the Work Group Chairs and the Director of the Evidence Review Team then assembled groups to be responsible for the development of the updates. These Work Groups and the Evidence Review Team collaborated closely throughout the project.

The Work Groups consisted of domain experts, including individuals with expertise in nephrology, surgery, radiology, pediatrics, nursing and nutrition. For each guideline update, the first task of the Work Group members was to define the overall topics and goals of the updates. They then further developed and refined each topic, literature search strategies, and data extraction forms. The Work Group members were the principal reviewers of the literature, and from their reviews and detailed data extractions, they summarized the available evidence and took the primary roles of writing the guidelines and rationale statements. Completed data extractions were posted on a National Kidney Foundation (NKF) website for direct access by Work Group members.

The Evidence Review Team consisted of nephrologists (one senior nephrologist and two nephrology fellows), methodologists, and research assistants from Tufts-New England Medical Center with expertise in systematic review of the medical literature. They instructed the Work Group members in all steps of systematic review and critical literature appraisal. The Evidence Review Team also coordinated the methodological and analytical process of the report, defined and standardize the methodology of performing literature searches, of data extraction, and of summarizing the evidence in summary tables. They organized abstract and article screening, created forms to extract relevant data from articles, organized Work Group member data extraction, and tabulated results. Throughout the project the Evidence Review Team led discussions on systematic review, literature searches, data extraction, assessment of quality and applicability of articles, evidence synthesis, and grading of the quality of the body of evidence and the strength of guideline recommendations.

Refinement of Update Topics and Development of Materials

The Work Group reviewed the 1995 Dialysis Outcomes Quality Initiative (DOQI) Clinical Practice Guidelines and the 2000 KDOQI updates and decided which of the guideline recommendations required updates and which should remain unchanged. These assessments were based primarily on expert opinion regarding the currency of the previous guidelines and the likelihood of availability of new evidence. Preliminary literature searches were made to inform this process. To allow for timely review, it was determined that each set of guidelines would be able to have systematic reviews on only a limited number of topics. After literature review, the experts decided which recommendations would be supported by evidence or by opinion.

The Work Groups and Evidence Review Team developed: a) draft guideline statements; b) draft rationale statements that summarized the expected pertinent

evidence; and c) data extraction forms containing the data elements to be retrieved from the primary articles. The topic refinement process began prior to literature retrieval and continued through the process of reviewing individual articles. Recommendations based on adequate evidence were categorized as Guidelines (CPGs), while opinion-based statements were categorized as Clinical Practice Recommendations (CPRs).

Rating the Strength of Recommendations

After literature review, the experts decided which recommendations were supported by evidence and which were supported by consensus of Work Group opinion. Evidence-based guideline recommendations were graded as strong (A) or moderate (B). Recommendations based on weak evidence (C) and/or consensus of expert opinion were labeled as Clinical Practice Recommendations (CPRs). See "Rating Scheme for the Strength of the Recommendations" below.

RATING SCHEME FOR THE STRENGTH OF THE RECOMMENDATIONS

The strength of each guideline recommendation is based on the quality of the supporting evidence as well as additional considerations. Additional considerations, such as cost, feasibility, and incremental benefit were implicitly considered.

A It is strongly recommended that clinicians routinely follow the guideline for eligible patients. There is strong evidence that the practice improves health outcomes.

B It is recommended that clinicians routinely follow the guideline for eligible patients. There is moderately strong evidence that the practice improves health outcomes.

CPR It is recommended that clinicians consider following the guideline for eligible patients. This recommendation is based on either weak evidence or on the opinions of the Work Group and reviewers that the practice might improve health outcomes.

Health outcomes are health-related events, conditions, or symptoms that can be perceived by individuals to have an important effect on their lives. Improving health outcomes implies that benefits outweigh any adverse effects.

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

As was the case with the initial Guidelines, the current guideline updates were subjected to a three-stage review process. They were presented first to the National Kidney Foundation Dialysis Outcomes Quality Initiative (NKF-DOQI) Steering Committee and revised in response to the comments received. In the second stage, the Kidney Disease Outcomes Quality Initiative (K/DOQI) Advisory Board, along with other experts in the field, provided comments. After considering these, the Work Groups produced a third draft of the guidelines. In the final stage, this draft was made available for public review and comment by all interested parties, including End-Stage Renal Disease (ESRD) Networks, professional and patient associations, dialysis providers, government agencies, product manufacturers, managed care groups, and individuals. The comments received were reviewed and, where appropriate, incorporated in the final version of the updated guideline.

RECOMMENDATIONS

MAJOR RECOMMENDATIONS

Definitions for the strength of each guideline or recommendation (A, B, or CPR), based on the quality of the supporting evidence as well as additional considerations, are provided at the end of the "Major Recommendations" field.

Clinical Practice Guidelines for Peritoneal Dialysis Adequacy

Guideline 1: Initiation of Dialysis

1.1 Preparation for kidney failure:

Patients who reach chronic kidney disease (CKD) stage 4 (estimated glomerular filtration rate [GFR] < 30 mL/min/1.73 m^2) should receive timely education about kidney failure and options for its treatment, including kidney transplantation, peritoneal dialysis (PD), hemodialysis (HD) in the home or in-center, and conservative treatment. Patients' family members and caregivers also should be educated about treatment choices for kidney failure. **[B]**

1.2 Estimation of kidney function:

Estimation of GFR should guide decision making regarding dialysis therapy initiation. GFR should be estimated by using a validated estimating equation (see Table 1 in the original guideline document) or by measurement of creatinine and urea clearances, not simply by measurement of serum creatinine and urea nitrogen. The tables below summarize special circumstances in which GFR estimates should be interpreted with particular care. **[B]**

Causes of Unusually Low or High Endogenous Creatinine Generation

Condition	Creatinine Generation
Vegetarian diet	Low
Muscle wasting	Low
Amputation	Low

Condition	Creatinine Generation
Spinal cord injury	Low
Advanced liver disease	Low
Muscular habitus	High
Asian race	Low

Causes of Unusually Low or High Kidney Tubular Creatinine Secretion

Drug or Condition	Kidney Tubular Creatinine Secretion
Trimethoprim	Low
Cimetidine	Low
Fibrates (except gemfibrozil)	Low
Advanced liver disease	High

1.3 Timing of therapy:

When patients reach stage 5 CKD (estimated GFR <15 mL/min/1.73 m^2), nephrologists should evaluate the benefits, risks, and disadvantages of beginning kidney replacement therapy (KRT). Particular clinical considerations and certain characteristic complications of kidney failure may prompt initiation of therapy before stage 5. **[B]**

Guideline 2: Peritoneal Dialysis Solute Clearance Targets and Measurements

Data from randomized controlled trials (RCTs) suggested that the minimally acceptable small-solute clearance for PD is less than the prior recommended level of a weekly Kt/V_{urea} of 2.0 (Kt/V_{urea} is urea nitrogen clearance divided by volume of distribution of urea nitrogen). Furthermore, increasing evidence indicates the importance of residual kidney function (RKF) as opposed to peritoneal small-solute clearance with respect to predicting patient survival. Therefore, prior targets have been revised as indicated next.

2.1 For patients with RKF (considered to be significant when urine volume is >100 mL/d):

2.1.1 The minimal "delivered" dose of total small-solute clearance should be a total (peritoneal and kidney) Kt/V_{urea} of at least 1.7 per week. **[B]**

2.1.2 Total solute clearance (residual kidney and peritoneal, in terms of Kt/V_{urea}) should be measured within the first month after initiating dialysis therapy and at least once every 4 months thereafter. **[B]**

2.1.3 If the patient has greater than 100 mL/d of residual kidney volume and residual kidney clearance is being considered as part of the patient's total weekly solute clearance goal, a 24-hour urine collection for urine volume and solute clearance determinations should be obtained at a minimum of every 2 months. **[B]**

2.2 For patients without RKF (considered insignificant when urine volume is $\leq$100 mL/d):

2.2.1 The minimal "delivered" dose of total small-solute clearance should be a peritoneal Kt/V_{urea} of at least 1.7 per week measured within the first month after starting dialysis therapy and at least once every 4 months thereafter. **[B]**

Guideline 3: Preservation of Residual Kidney Function

Prospective randomized trials of dialysis adequacy and many observational studies have confirmed a strong association between the presence of RKF and reduction of mortality in patients on PD therapy.

3.1 It is important to monitor and preserve RKF. **[A]**

3.2 In the patient with RKF who needs antihypertensive medication, preference should be given to the use of angiotensin-converting enzyme (ACE) inhibitors or angiotensin receptor blockers (ARBs). **[A]**

3.3 In the normotensive patient with RKF, consideration should be given to the use of ACE inhibitors or ARBs for kidney protection. **[B]**

3.4 Insults to RKF (see the following table) in patients with CKD also should be considered insults to RKF in PD patients and should be avoided when possible. **[B]**

Potential Insults to RKF in Patients on Dialysis

Radiographic dye administered intravenously or intra-arterially
Aminoglycoside antibiotics
Nonsteroidal anti-inflammatory drugs (NSAIDS), including COX-2 inhibitors
ECF volume depletion
Urinary tract obstruction
Hypercalcemia
Withdrawal of immunosuppressive therapy from a transplanted kidney

COX-2: Cyclooxygenase-2; ECF: Extracellular fluid

Guideline 4: Maintenance of Euvolemia

Volume overload is associated with congestive heart failure (CHF), left ventricular hypertrophy (LVH), and hypertension; therefore, it is important to monitor ultrafiltration volume, dry weight, sodium intake, and other clinical assessments of volume status.

4.1 Each facility should implement a program that monitors and reviews peritoneal dialysate drain volume, RKF, and patient blood pressure on a monthly basis. **[B]**

4.2 Some of the therapies one should consider to optimize extracellular water and blood volume include, but are not limited to, restricting dietary sodium and water intake, use of diuretics in patients with RKF, and optimization of peritoneal ultrafiltration volume and sodium removal. **[B]**

Guideline 5: Quality Improvement Programs

The continuous quality improvement (CQI) process has been shown to improve outcomes in many disciplines, including CKD stage 5.

5.1 Each home-training unit should establish quality improvement programs with the goal of monitoring clinical outcomes and implementing programs that result in improvements in patient care. **[B]**

5.2 Quality improvement programs should include representatives of all disciplines involved in the care of the PD patient, including physicians, midlevel practitioners, nurses, social workers, dietitians, and administrators. **[B]**

5.3 Suggested domains of clinical activities one should consider monitoring are listed in the table below. **[B]**

Various Domains to Be Considered for CQI Studies

1. Peritonitis rates
2. Exit-site infection rates
3. Technique failure rates
4. Patient satisfaction
5. Quality of life (QOL)
6. Catheter-related problems and catheter survival rates
7. Other domains, outlined in other parts of the original guideline document, such as adequacy measures, anemia and bone and mineral metabolism management, blood pressure and volume control, lipid control, etc.

Guideline 6: Pediatric Peritoneal Dialysis

The provision of evidence-based pediatric PD adequacy guidelines is hampered by a number of epidemiological issues. CKD stage 5 remains a relatively uncommon disease in children, while kidney transplantation is still the predominant mode of KRT. In addition, HD is a viable modality option for many pediatric patients, especially adolescents. Finally, children with CKD stage 5 show significantly better survival rates compared with adult patients. As a result of these factors, no long-term pediatric outcome study similar to the ADEMEX Study is adequately powered to detect an effect of the delivered PD dose on pediatric patient outcome. Nevertheless, pediatric data exist, for example, to describe the most accurate methods for assessing peritoneal membrane transport capacity and quantifying urea removal. These data and others can serve as a basis for Clinical Practice

Guidelines (CPGs) in children receiving PD. For areas in which no pediatric-specific data exist, the CPGs and Clinical Practice Recommendations (CPRs) for adult patients should serve as a minimum standard for pediatric patients, but the overall clinical "wellness" of the individual pediatric patient should be the primary factor that influences the quantity and quality of the care provided.

6.1 Recommended laboratory measurements for peritoneal membrane function:

6.1.1 The peritoneal equilibration test (PET) is the preferred approach to the clinical assessment of peritoneal membrane transport capacity in pediatric patients and should be performed to aid in the prescription process. **[A]**

6.2 Maintenance of euvolemia and normotension:

6.2.1 The frequent presence of hypertension and associated cardiac abnormalities in children receiving PD requires strict management of blood pressure, including attention to fluid status. **[A]**

6.3 Quality improvement programs:

6.3.1 The CQI process has been shown to improve outcomes in many disciplines, including CKD stage 5. **[A]**

6.3.1.1 Each home training unit should establish quality improvement programs with the goal of monitoring clinical outcomes and implementing programs that result in improvements in patient care. In children, growth and school attendance/performance are clinical activities to be monitored in addition to those recommended for adult patients.

6.3.1.2 Quality improvement programs should include representatives of all disciplines involved in the care of the pediatric PD patient, including physicians, nurses, social workers, dietitians, play therapists, psychologists, and teachers.

6.3.1.3 Single-center trends in pediatric clinical outcomes should be compared with national and international data.

Clinical Practice Recommendations for Peritoneal Dialysis Adequacy

Clinical Practice Recommendation for Guideline 1: Initiation of Kidney Replacement Therapy

There is variability with regard to when a patient should be started on dialysis.

1.1 Kidney replacement therapy may be started earlier for a variety of reasons, as outlined in the following table.

Indications for Early Dialysis Start

Intractable fluid overload
Intractable hyperkalemia
Malnutrition felt to be related to uremia
Uremic neurological dysfunction
Uremic serositis
Declining functional status otherwise unexplained
Neurologic dysfunction (e.g., neuropathy, encephalopathy)
Prediction of access difficulty

1.2 Uremic cognitive dysfunction can affect learning. Therefore, the initiation of home-based self-dialysis may need to occur at an earlier point than that for center-assisted dialysis.

1.3 Kidney replacement therapy may be delayed if the patient is asymptomatic, is awaiting imminent kidney transplant, is awaiting imminent placement of permanent HD or PD access, or, after appropriate education, has chosen conservative therapy.

1.3.1 If KRT is delayed, the patient should be re-evaluated on a regular basis to determine when KRT should be initiated.

1.3.2 Nephrologists should actively participate in the care of patients who choose conservative therapy, and should consider conservative treatment of kidney failure as an integral part of their clinical practice.

1.3.3 If, for any reason, KRT is not instituted, patients with estimated GFR <15 mL/min/1.73 m^2 should be re-evaluated by a nephrologist at frequent intervals.

1.4 Choice of modality:

1.4.1 Patients who choose PD for their modality should not be required to have a HD access placed. However, venous sites for possible future HD access in the arms should be preserved since many patients require multiple modalities during their remaining lifetime.

1.4.2 Patients who chose cycler dialysis for lifestyle reasons can begin dialysis without an intervening period on continuous ambulatory peritoneal dialysis (CAPD); however, some programs may wish to train all patients on the CAPD technique for various reasons.

1.5 In the patient with significant RKF, consideration may be given to an incremental start of dialysis (i.e., less than a "full" dose of PD).

Clinical Practice Recommendations for Guideline 2: Peritoneal Dialysis Prescription Targets and Measurements

In a PD prescription, there are certain general considerations.

2.1 Regardless of delivered dose, if a patient is not thriving and has no other identifiable cause other than possible kidney failure, consideration should be given to increasing dialysis dose (see the following table).

Possible Indications To Consider Increasing the Dose of Dialysis

Uremic neuropathy
Uremic pericarditis
Nausea or vomiting otherwise unexplained
Sleep disturbance
Restless leg syndrome
Pruritus
Uncontrolled hyperphosphatemia
Evidence of volume overload
Hyperkalemia
Metabolic acidosis unresponsive to oral bicarbonate therapy
Anemia

2.2 In a patient with minimal RKF, a continuous (rather than intermittent) 24 h/d of PD dwell PD prescription should be used to maximize middle-molecule clearance.

2.3 If either peritoneal Kt/V_{urea} is at least 1.7 or 24-hour urine output is less than 100 mL, monitoring of RKF is not required for monitoring the dose of PD. However, periodic measurement of RKF may be of value in this group of patients for the reasons noted in the following table.

Possible Clinical Indications for Obtaining a 24-Hour RKF Collection

Small-solute clearance measurement
24-hour urine volume
24-hour urine sodium excretion
Creatinine generation rate

2.4 All measurements of peritoneal solute clearance should be obtained when the patient is clinically stable and at least 1 month after resolution of an episode of peritonitis.

2.5 More frequent measurements of either peritoneal urea clearance or RKF should be obtained when clinically indicated (see the table below).

Clinical Indications for Measurement of Peritoneal or Kidney Clearance

Routine monitoring of total solute clearance
Documentation of delivered total solute clearance after a prescription change
Patient who has failure to thrive
Patient who is hypertensive or volume-overloaded
During an occasional evaluation of any other unsuspected clinical problem

2.6 When calculating Kt/V_{urea}, one should estimate volume distribution of urea nitrogen (V) from either the Watson or Hume equation in adults. In the absence of evidence, use of the patients' ideal or standard (rather than actual) weight should be considered in the calculation V.

2.7 The determination of peritoneal creatinine clearance (C_{Cr}) is of little added value for predicting risk for death; therefore, for simplicity, adequacy targets are based on urea kinetics only. Peritoneal creatinine excretion rate may be used to monitor estimates of muscle mass over time.

2.8 During the monthly evaluation of the PD patient, nutritional status should be estimated. Serum albumin levels should be monitored, and when obtaining 24-hour total solute clearances, estimations of dietary protein intake (DPI; such as normalized protein equivalent of total nitrogen appearance [nPNA]) should be measured.

Clinical Practice Recommendations 3: Recommended Laboratory Measurements for Peritoneal Membrane Function and Ultrafiltration Volume

Total solute clearance and peritoneal effluent volume ultimately are influenced by peritoneal membrane transport characteristics. Multiple tests are documented to be efficacious for determining peritoneal membrane transport. None of these tests has been shown to be clinically superior to the others (see the following table).

Standard Tests for Evaluating Peritoneal Membrane Transport/Function

	Method of Peritoneal Function Testing		
Aspect of Peritoneal Function	**PET**	**SPA**	**PDC**
Small solute transport	D/P creatinine	MTAC creatinine	Area permeability

	Method of Peritoneal Function Testing		
Aspect of Peritoneal Function	**PET**	**SPA**	**PDC**
Ultrafiltration capacity	Drain volume	Drain volume	Estimates ultrafiltration coefficient
Ultrafiltration via water channels	D/P Na	Model for Na channel	-
Fluid absorption	-	Dextran 70	Derived
Peritoneal blood flow	-	-	-
Permeability to macromolecules	-	Restriction coefficients	Large-pore flow

Abbreviations: PET, peritoneal equilibration test; SPA, standard peritoneal permeability analysis; PDC, peritoneal dialysis capacity test; D/P, dialysate to plasma ratio; Na, sodium; MTAC, mass transfer area coefficients

3.1 Each center should choose one of these tests to use when characterizing peritoneal transport in their patients.

3.2 Baseline peritoneal membrane transport characteristics should be established after initiating a daily PD therapy.

3.3 Data suggest that it would be best to wait 4 to 8 weeks after starting dialysis to obtain this baseline measurement.

3.4 Peritoneal membrane transport testing should be repeated when clinically indicated (see the following table).

Clinical Indications for Repeat Peritoneal Membrane Transport Testing

Presence of unexplained volume overload
Decreasing drain volume (DV) on: overnight dwell (CAPD), or daytime dwell (APD)
Increasing clinical need for hypertonic dialysate dwells to maintain DV
Worsening of hypertension
Change in measured peritoneal solute removal (Kt/V_{urea})
Unexplained signs or symptoms of uremia

Abbreviations: CAPD, continuous ambulatory peritoneal dialysis; APD, automated peritoneal dialysis; Kt/V_{urea}, Urea nitrogen clearance divided by volume of distribution of urea nitrogen

3.5 All measurements of peritoneal transport characteristics should be obtained when the patient is clinically stable and at least 1 month after resolution of an episode of peritonitis.

Clinical Practice Recommendations 4: Writing the Peritoneal Dialysis Prescription

The PD modality has an impact on adherence and quality of life (QOL), which are important considerations in writing a PD prescription. Ultrafiltration, which is important in optimizing volume control and thus patient survival, is dependent on the prescription and peritoneal membrane characteristics. Clearance of middle molecules, while not proved to influence patient survival, should be an important consideration in the prescription.

4.1 The patient's schedule and QOL should be taken into account when prescribing PD.

4.2 To optimize middle-molecule clearance in patients who have minimal RKF, the PD prescription should preferentially include dwells for the majority of the 24-hour day. This is recommended even if small-molecule clearance is above target without the longer dwell.

4.3 As tolerated by the patient, to optimize small-solute clearance and minimize cost, one should first increase instilled volume per exchange before increasing the number of exchanges per day. The exchange volume of the supine exchange(s) should be increased first because this position has the lowest intra-abdominal pressure.

4.4 The patient's record of PD effluent volume should be reviewed monthly, with particular attention to the drain volume from the overnight dwell(s) of CAPD and the daytime dwell(s) of automated peritoneal dialysis (APD).

4.5 A number of techniques can be used to optimize volume and blood pressure control.

> 4.5.1 To achieve the desired volume status, the lowest possible dialysate dextrose concentration should be used.
>
> 4.5.2 When appropriate, implement dietary sodium and fluid restriction.
>
> 4.5.3 In patients with RKF, to achieve dry weight, diuretics may be preferred to increasing dialysate dextrose concentration.
>
> 4.5.4 Drain volume should be optimized during the overnight dwell(s) of CAPD and the daytime dwell(s) of APD to maximize solute clearance and ultrafiltration volume.
>
> 4.5.5 In patients who are hypertensive or who show evidence of volume overload, ultrafiltration generally should not be negative (i.e., no absorption) for any daytime or nighttime exchanges.

Clinical Practice Recommendations for Guideline 6: Pediatric Peritoneal Dialysis

6.1 Dialysis initiation:

6.1.1 Dialysis initiation should be *considered* for the pediatric patient when GFR is 9 to 14 mL/min/1.73 m^2 body surface area (BSA) and should be *recommended* when GFR is 8 mL/min/1.73 m^2 or less. GFR can be estimated by either averaging the measured creatinine and urea clearances by using a timed urine collection, using the Schwartz formula, or using a timed urine collection to determine C_{Cr} after a dose of cimetidine. Dialysis therapy initiation should be considered at the greater estimated GFR levels when the patient's clinical course is complicated by the presence of malnutrition, fluid overload, hypertension, hyperkalemia, hyperphosphatemia, acidosis, growth failure/decreasing height velocity, or neurological consequences of uremia. Before dialysis is undertaken, these conditions should be shown to be persistent and refractory to medication and/or dietary management.

6.2 Modality selection:

6.2.1 The decision regarding the selection of PD as a dialysis modality for the pediatric patient should take a variety of factors into account, including patient/family choice, patient size, medical comorbidities, and family support.

6.3 Solute clearance targets and measurements:

6.3.1 In the absence of definitive data correlating solute removal and clinical outcome in children, current recommendations for solute clearance in pediatric patients receiving PD are as follows:

6.3.1.1 The pediatric patient's clinical status should be reviewed at least monthly, and delivery of the prescribed solute clearance should render the patient free of signs and symptoms of uremia.

6.3.1.2 All measurements of peritoneal solute clearance should be obtained when the patient is clinically stable and at least 1 month after resolution of an episode of peritonitis.

6.3.1.3 More frequent measurements of peritoneal solute clearance and RKF should be considered when clinical events are likely to have resulted in decreased clearance or when new/worsening signs or symptoms of uremia develop.

6.3.1.4 Regardless of the delivered dose of dialysis, if a patient is not doing well and has no other identifiable cause other than kidney failure, a trial of increased dialysis is indicate.

6.3.2 For patients with RKF (defined as urine $Kt/V_{urea} > 0.1$/wk):

6.3.2.1 The minimal "delivered" dose of total (peritoneal and kidney) small-solute clearance should be a Kt/V_{urea} of at least 1.8/wk.

6.3.2.2 Total solute clearance should be measured within the first month after initiating dialysis and at least once every 6 months thereafter.

6.3.2.3 If the patient has RKF and residual kidney clearance is being considered as part of the patient's total weekly solute clearance goal, a 24-hour urine collection for urine volume and solute clearance determinations should be obtained at a minimum of every 3 months.

6.3.3 For patients without RKF (defined as urine $Kt/V_{urea} < 0.1/wk$) or for those in whom RKF is unable to be measured accurately:

6.3.3.1 The minimal "delivered" dose of small-solute clearance should be a peritoneal Kt/V_{urea} of at least 1.8/wk.

6.3.3.2 The peritoneal solute clearance should be measured within the first month after starting dialysis and *at least* once every 6 months thereafter.

6.3.4 When calculating Kt/V_{urea}, one should estimate V or total body water (TBW) by using the sex-specific nomograms based upon the following equations:

Males: $TBW = 0.010 \times (height \times weight)^{0.68} - 0.37 \times weight$

Females: $TBW = 0.14 \times (height \times weight)^{0.64} - 0.35 \times weight$

6.4 Preservation of RKF:

6.4.1 Techniques that may contribute to the preservation of RKF in pediatric patients receiving PD should be incorporated as a component of dialysis care whenever possible.

6.4.1.1 Nephrotoxic insults in those with normal or impaired kidney function should be assumed, in the absence of direct evidence, to also be nephrotoxic in patients on PD therapy who have RKF and therefore should be avoided.

6.4.1.2 Aminoglycoside antibiotics should be avoided whenever possible to minimize the risk for nephrotoxicity, as well as ototoxicity and vestibular toxicity.

6.4.1.3 "Prekidney" and "postkidney" causes of a decrease in RKF should be considered in the appropriate clinical setting.

6.4.1.4 Infections of the urinary tract should be treated promptly.

6.4.1.5 Diuretics should be used to maximize urinary salt and water excretion.

6.4.1.6 An ACE inhibitor or ARB should be considered in a PD patient who requires antihypertensive medication and has RKF.

6.5 Writing the PD prescription:

6.5.1 In addition to solute clearance, QOL, ultrafiltration/volume control, and possibly the clearance of middle molecules should be considered when writing the PD prescription.

6.5.1.1 The patient's dialysis schedule and QOL as it relates to such issues as school and work attendance/performance should be taken into account when designing the dialysis prescription.

6.5.1.2 To optimize small-solute clearance, minimize cost, and possibly decrease the frequency of exchanges, one should first increase the instilled volume per exchange (target range, 1,000 to 1,200 mL/m^2 BSA; maximum, 1,400 mL/m^2 BSA), as tolerated by the patient, before increasing the number of exchanges per day. The volume of the supine exchange(s) should be increased first because this position has the lowest intra-abdominal pressure. Objective evidence of patient tolerance may require assessment of intraperitoneal pressure (IPP).

6.5.1.3 The patient's record of PD effluent volume should be reviewed monthly, with particular attention to the drain volume from the overnight dwell of CAPD and daytime dwell of continuous cycling peritoneal dialysis (CCPD).

6.5.1.4 Factors to be considered when attempting to optimize total body volume include:

a. Dietary sodium and fluid restriction may be implemented in patients unable to maintain euvolemia/normotension with dialysis alone.
b. In patients with RKF, diuretics may be preferred over increasing the dialysate dextrose concentration to achieve euvolemia.
c. Drain volume should be optimized after the overnight dwell of CAPD and the daytime dwell(s) of continuous cycling peritoneal dialysis (CCPD) to maximize solute clearance and ultrafiltration volume.
d. In patients who are hypertensive or in whom there is evidence of volume overload, ultrafiltration generally should be positive for all daytime or nighttime exchanges.
e. An effort should be made to determine the lowest possible dialysate dextrose concentration required to achieve the desired ultrafiltration volume.

6.5.1.5 To optimize middle-molecule clearance in patients who have minimal

RKF, the PD prescription should preferentially include the use of CCPD with dwells 24 h/d or CAPD. This is recommended even if small-molecule clearance is above target without the longer dwell.

6.5.1.6 The use of nightly intermittent peritoneal dialysis (NIPD) (e.g., no daytime dwell) can be considered in pediatric patients who are clinically well, whose combined dialysis prescription and RKF achieves or exceeds the target solute clearance, and who are without evidence of hyperphosphatemia, hyperkalemia, hypervolemia, or acidosis.

6.6 Other aspects of the care of the pediatric PD patient:

6.6.1 All children on PD therapy with anemia should follow the Kidney Disease Outcomes Quality Initiatives (KDOQI) Guidelines for Management of Anemia that pertain to pediatrics ("NKF-K/DOQI clinical practice guidelines for anemia," 2001, 2006).

6.6.2 Management of dyslipidemias for prepubertal children on PD therapy should follow recommendations by the National Cholesterol Expert Panel in Children and Adolescents ("Report of the Expert Panel," 1992). Postpubertal children or adolescents on PD therapy should follow the pediatric recommendations provided in the KDOQI Clinical Practice Guidelines for Managing Dyslipidemia in CKD (National Kidney Foundation, 2003).

6.6.3 All children on PD therapy should follow the pediatric-specific recommendations provided in the KDOQI Clinical Practice Guidelines for cardiovascular disease (CVD) in Dialysis Patients and the KDOQI Clinical Practice Guidelines on Hypertension and Antihypertensive Agents in CKD (National Kidney Foundation, 2005; "K/DOQI clinical practice guidelines on hypertension," 2004).

6.6.4 All children on PD therapy should follow the recommendations provided in the KDOQI Clinical Practice Guidelines for

Nutrition in Chronic Renal Failure ("Clinical practice guidelines for nutrition," 2000).

Definitions:

Rating the Strength of Guideline Recommendations

The strength of each guideline recommendation is based on the quality of the supporting evidence as well as additional considerations. Additional considerations, such as cost, feasibility, and incremental benefit were implicitly considered.

A It is strongly recommended that clinicians routinely follow the guideline for eligible patients. There is strong evidence that the practice improves health outcomes.

B It is recommended that clinicians routinely follow the guideline for eligible patients. There is moderately strong evidence that the practice improves health outcomes.

CPR It is recommended that clinicians consider following the guideline for eligible patients. This recommendation is based on either weak evidence or on the opinions of the Work Group and reviewers that the practice might improve health outcomes.

Health outcomes are health-related events, conditions, or symptoms that can be perceived by individuals to have an important effect on their lives. Improving health outcomes implies that benefits outweigh any adverse effects.

Rating the Quality of Evidence

The quality of evidence was not explicitly graded. It was implicitly assessed according to the criteria outlined in the table below, and considered: i) the methodological quality of the studies; ii) whether or not the studies were carried out in the target population (i.e., patients on dialysis, or in other populations) and iii) whether the studies examined health outcomes directly, or examined surrogate measures for those outcomes (e.g., blood flow instead of access survival.)

		Methodological Quality		
Outcome	Population	Well designed	Some problems	Poorly

		Methodological Quality		
		and analyzed (little, if any, potential bias)	in design and/or analysis (some potential bias)	designed and/or analyzed (large potential bias)
Health outcome(s)	Target population	Strong[a]	Moderately Strong[b]	Weak[h]
Health outcome(s)	Other than the target population	Moderately Strong[c]	Moderately Strong[d]	Weak[h]
Surrogate measure for health outcome(s)	Target population	Moderately Strong[e]	Weak[f]	Weak[h]
Surrogate measure for health outcome(s)	Other than the target population	Weak[g]	Weak[g]	Weak[g,h]

Definitions:

Strong: [a]Evidence includes results from well-designed, well-conducted study/studies in the target population that directly assess effects on health outcomes.

Moderately Strong: [b]Evidence is sufficient to determine effects on health outcomes in the target population, but the strength of the evidence is limited by the number, quality, or consistency of the individual studies. [c]OR evidence is from a population other than the target population, but from well-designed, well-conducted studies; [d]OR evidence is from studies with some problems in design and/or analyses.; [e]OR evidence is from well-designed, well-conducted studies or surrogate endpoints for efficacy and/or safety in the target population.

Weak: [f]Evidence is insufficient to assess the effects on net health outcomes because it is from studies with some problems in design and/or analysis on surrogate endpoints for efficacy and/or safety in the target population; [g]OR the evidence is only for surrogate measures in a population other than the target population; [h]OR the evidence is from studies that are poorly designed and/or analyzed.

CLINICAL ALGORITHM(S)

None provided

EVIDENCE SUPPORTING THE RECOMMENDATIONS

REFERENCES SUPPORTING THE RECOMMENDATIONS

References open in a new window

TYPE OF EVIDENCE SUPPORTING THE RECOMMENDATIONS

The type of supporting evidence is identified and graded for each recommendation (see "Major Recommendations").

BENEFITS/HARMS OF IMPLEMENTING THE GUIDELINE RECOMMENDATIONS

POTENTIAL BENEFITS

- Delivery of adequate peritoneal dialysis dose in patients with end-stage renal disease (ESRD)
- Preservation of kidney function
- Decreased morbidity and mortality for patients with ESRD receiving peritoneal dialysis
- Increased patient survival
- Improved quality of life

POTENTIAL HARMS

Peritonitis remains a leading cause of morbidity for (peritoneal dialysis) PD patients and has been associated with mortality, hospitalizations, and termination of PD therapy.

CONTRAINDICATIONS

CONTRAINDICATIONS

- Absolute and relative contraindications to the use of peritoneal dialysis (PD) include the following:

  Absolute Contraindications

  - Omphalocele
  - Gastroschisis
  - Bladder extrophy
  - Diaphragmatic hernia
  - Obliterated peritoneal cavity
  - Peritoneal membrane failure

  Relative Contraindications

  - Inadequate living situation for home dialysis
  - Lack of appropriate caregiver
  - Impending/recent major abdominal surgery

    - Imminent living-related donor transplantation (within 6 months of dialysis initiation)
- Insults to residual kidney function (RKF) (see table in Guideline 3 of "Major Recommendations" field) in patients with chronic kidney disease also should be considered insults to RKF in peritoneal patients and should be avoided when possible.

QUALIFYING STATEMENTS

QUALIFYING STATEMENTS

- These Clinical Practice Guidelines (CPGs) and Clinical Practice Recommendations (CPRs) are based upon the best information available at the time of publication. They are designed to provide information and assist 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. (See "Limitations" sections in the original guideline document for more detailed information specific to each guideline.) Every healthcare professional making use of these CPGs and CPRs is responsible for evaluating the appropriateness of applying them in the setting of any particular clinical situation. The recommendations for research contained within this document are general and do not imply a specific protocol.
- These guidelines are primarily for patients on continuous ambulatory peritoneal dialysis (CAPD) therapy. There are limited data for automated peritoneal dialysis (APD) and no randomized controlled trials (RCTs). Therefore, the guideline authors cannot formulate guidelines for APD, and any comments on this form of therapy are mainly opinion based.
- Despite voicing concerns in the original Dialysis Outcomes Quality Initiative (DOQI) publications, at times guidelines were used by oversight bodies in a way not intended by the Work Group and - at other times - not in keeping with the spirit in which the guidelines were formulated. As a result, this publication is organized differently, into: (1) Clinical Practice Guidelines (CPGs); and

(2) Clinical Practice Recommendations (CPRs). The guidelines are based on available evidence such as it exists. Much more information is needed; therefore, the guideline authors would strongly discourage oversight bodies from using these CPGs for clinical performance measurements. The CPRs are based on weak evidence or opinion and as such, should not be used for clinical performance measurements. In particular, because of the absence of RCTs for patients on APD therapy, no clinical performance measurements regarding this form of therapy are appropriate. Guidelines are meant to inform, but not replace, clinical judgment.

- The authors express some caveats and cautions about the guidelines. In contrast to the original guidelines, in which a target total solute clearance was recommended, in the present guidelines, a minimal dose is recommended. When using a target, even if a patient was below target, solute clearance would still likely be adequate. Conversely, when using a minimal dose, there is less room for error. All patients should be above the minimal. Additionally, data from prospective randomized trials are based on relatively short-term trials of patients on peritoneal dialysis (PD) therapy in Mexico and Hong Kong. These patients likely are on different protein intakes and perhaps are more likely to be adherent with the PD prescription than the typical patient in the United States. As a result, the current document emphasizes patient observations and adjustment of the PD prescription if the patient is not doing well clinically. There is a paucity of knowledge regarding small-molecule clearance targets and long-term complications, such as calcium-phosphate product effects and uremic neuropathy. Additional data are required to make recommendations for optimization of long-term health.

IMPLEMENTATION OF THE GUIDELINE

DESCRIPTION OF IMPLEMENTATION STRATEGY

Implementation is an integral component of the Kidney Disease Outcomes Quality Initiative process, and accounts for the success of its past guidelines. The Kidney Learning System (KLS) component of the National Kidney Foundation is developing

implementation tools that will be essential to the success of these guidelines.

Implementation Issues for Clinical Practice Guidelines

Guideline 2: Peritoneal Dialysis Solute Clearance Targets and Measurements

The prescribed dose of peritoneal dialysis (PD), as is true of hemodialysis (HD), is not invariably the delivered dose. Patients adjust the timing of exchanges, eliminate exchanges, and change the dextrose of the dialysis solution, resulting in variations in ultrafiltration that, in turn, affect small-molecule clearance. Patients are responsible for their dialysis delivery, yet depression is common in PD patients, which may impact on adherence. Close attention must be paid to the patient's ability to perform (mentally and physically) his or her dialysis.

Furthermore, residual kidney function (RKF) does not remain stable. It is affected by volume status and tends to decrease over time. Therefore, if including residual kidney clearance as part of total Kt/V_{urea}, the measured dose of Kt/V_{urea} may not precisely reflect the delivered dose of Kt/V_{urea}, which will be less in some cases (where Kt/V_{urea} is urea nitrogen clearance divided by the volume of distribution of urea nitrogen). This means that the clinician should err on the side of a higher prescribed dose when possible.

Implementation of the goal of euvolemia in PD patients involves close monitoring of urine volume, ultrafiltration, and physical examination, including blood pressure. Both home records and in-center measurements are needed. Frequent contact with the patient to supervise the use of the appropriate dialysis dextrose solution is necessary. The use of loop diuretics may be indicated to increase urine volume as appropriate (discussed later). "Negative" ultrafiltration with the long exchange should be avoided by adjusting the prescription and dialysate dextrose solution.

Guideline 3: Preservation of Residual Kidney Function

Whether urine volume, small-solute clearance, or some other kidney-related factor is responsible for the decrease in mortality associated with RKF, it is important to have some measure of this residual

function. It is impracticable to use exacting tests to calculate this, such as inulin clearance or radionucleotide measurements. The average of urea nitrogen and creatinine clearance (C_{Cr}) has been shown to have a reasonable approximation of RKF. However, the accuracy of this measurement depends on the careful collection of 24-hour urine. Especially in patients with very little function, inaccuracy in the timing of the collection can lead to incorrect results. Accuracy perhaps can be improved by the collection of a 72-hour sample and dividing the result by 3; however, this is a time-consuming and cumbersome process. Patients will need to be instructed on the careful collection of 24-hour urine and make it a habit to bring these collections as part of the regular clinic visit. Use of angiotensin converting enzyme (ACE) inhibitors and angiotensin receptor blockers (ARBs) may add to the cost of medications for patients. In addition, there is a risk for cough, particularly with ACE inhibitors. There also is a theoretical risk for hyperkalemia, although this has not been found in studies to date.

Guideline 4: Maintenance of Euvolemia

Implementation of these guidelines requires patients to have regular clinic visits and physical examinations. These generally should be monthly after the patient is established on PD therapy, but should be more frequent during and in the first weeks after initial training. Less frequent visits may be acceptable if the patient is stable on PD therapy with good blood pressure and volume status.

Access to dietitian assistance will be required to assess and advise patients about sodium and fluid intake. Use of icodextrin requires access to this solution, which is not available in some jurisdictions and which is limited by cost considerations in others.

Implementation Issues for Clinical Practice Recommendations

Clinical Practice Recommendation for Guideline 1: Initiation of Dialysis

Monitoring of patients in whom dialysis is delayed may be difficult if the resources are not available. Given the increasing shortage of nephrologists in the face of increasing numbers of patients with advanced kidney failure, new approaches are needed. One approach might be to use renal nurse practitioners

and physician assistants, to closely follow patients in whom the decision to defer dialysis has been made. Protocols could be constructed to trigger referral for start of dialysis in such situations.

Clinical Practice Recommendations for Guideline 2: Peritoneal Dialysis Prescription Targets and Measurements

Obtaining a clearance in PD patients is very dependent on the cooperation of the patient. The patient must bring the used dialysate to the dialysis unit. This may be difficult for elderly or weak patients unable to lift heavy objects or those with limited transportation. If the patient is told to sample the effluent and record the weight (for continuous ambulatory peritoneal dialysis [CAPD]) or drain volume (for automated peritoneal dialysis [APD]), the center is dependent on the patient providing the correct numbers. Furthermore, on the day of the clearance, the patient is more likely to do the proper full prescription. Therefore, the measurement, at best, is that of that particular day's dialysis and not necessarily reflective of average clearance. To some extent, use of a cycler with a mechanism of monitoring the use of the cycler and time on the cycler could be used. This cycler is not universally available and increases the cost of treatment.

Clinical Practice Recommendations for Guideline 3: Recommended Laboratory Measurements for Peritoneal Membrane Function and Ultrafiltration Volume

Most centers are already using standard peritoneal equilibration test (PET) in clinical practice. Many are routinely monitoring transport changes over time (most on a yearly basis, although the prior Kidney Disease Outcomes Quality Initiative (KDOQI) PD Adequacy Guidelines recommended more frequent monitoring). These Clinical Practice Recommendations (CPRs) are less demanding than the original KDOQI PD Adequacy Guidelines and - as CPRs instead of Clinical Practice Guidelines (CPGs) - should make implementation easier because there will be no related performance measures.

Clinical Practice Recommendations for Guideline 4: Writing the Peritoneal Dialysis Prescription

Implementation of these recommendations requires only that patients be carefully evaluated monthly. At

the evaluations, ultrafiltration and clearance requirements should be reviewed, with particular attention to how the prescription is affecting quality of life (QOL) and whether the patient is adherent to it. Appropriate changes could then be made.

IMPLEMENTATION TOOLS

Foreign Language Translations
Patient Resources
Quick Reference Guides/Physician Guides
Resources

For information about availability, see the "Availability of Companion Documents" and "Patient Resources" fields below.

INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT CATEGORIES

IOM CARE NEED

Living with Illness

IOM DOMAIN

Effectiveness
Patient-centeredness

IDENTIFYING INFORMATION AND AVAILABILITY

BIBLIOGRAPHIC SOURCE(S)

Peritoneal Dialysis Adequacy Work Group. Clinical practice guidelines for peritoneal dialysis adequacy. Am J Kidney Dis 2006 Jul;48 Suppl 1:S98-129. PubMed

ADAPTATION

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

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GUIDELINE DEVELOPER(S)

National Kidney Foundation - Disease Specific Society

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GUIDELINE COMMITTEE

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FINANCIAL DISCLOSURES/CONFLICTS OF INTEREST

The National Kidney Foundation makes every effort to avoid any actual or potential conflicts of interest that may arise as a result of an outside relationship or a personal, professional, or business interest of a member of the Work Group.

Specifically, all members of the Work Group are required to complete, sign, and submit a Disclosure Questionnaire showing all such relationships that might be perceived as real or potential conflicts of interest.

- Dr Bargman has received research funds, grants, or contracts from Amgen, Baxter Healthcare, Fresenius Medical Care, and Gambro Healthcare.
- Dr Blake has received lecture fees from Amgen, Baxter Healthcare, and Ortho Biotech.
- Dr Burkart has received research funds, grants, or contracts from Baxter Healthcare, Genzyme, and Fresenius Medical Care.
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GUIDELINE STATUS

This is the current release of the guideline.

This guideline updates a previous version: NKF-K/DOQI clinical practice guidelines for peritoneal dialysis adequacy: update 2000. Am J Kidney Dis 2001 Jan;37(1 Suppl 1):S65-S136.

GUIDELINE AVAILABILITY

Electronic copies: Available from the National Kidney Foundation (NKF) Web site.

Print copies: Available from the National Kidney Foundation (NKF), 30 East 33rd St., New York, NY 10016. These guidelines are also available on CD-ROM from NKF.

AVAILABILITY OF COMPANION DOCUMENTS

The following are available:

- Dialysis care package
- Dialysis care clinical practice guidelines and recommendations (CD-ROM)
- KDOQI in the dialysis center: a quick reference guide
- CKD: a guide to select NKF-KDOQI guidelines and recommendations 2006

These materials are available by contacting: National Kidney Foundation 30 East 33rd Street, New York, NY 10016 (phone: 212.889.2210 or 800.622.9010 or fax: 212.686.8916), or through the National Kidney Foundation Web site.

PATIENT RESOURCES

The following are available:

- Peritoneal dialysis: What you need to know (also available in Spanish)
- Choosing a treatment for kidney failure
- People like us: peritoneal dialysis (also available in Spanish)

- Dialysis patients' bill of rights and responsibilities
- Nutrition and peritoneal dialysis

These patient education materials are available by contacting: National Kidney Foundation 30 East 33rd Street, New York, NY 10016 (phone: 212.889.2210 or 800.622.9010 or fax: 212.686.8916), or through the National Kidney Foundation Web site.

Please note: This patient information is intended to provide health professionals with information to share with their patients to help them better understand their health and their diagnosed disorders. By providing access to this patient information, it is not the intention of NGC to provide specific medical advice for particular patients. Rather we urge patients and their representatives to review this material and then to consult with a licensed health professional for evaluation of treatment options suitable for them as well as for diagnosis and answers to their personal medical questions. This patient information has been derived and prepared from a guideline for health care professionals included on NGC by the authors or publishers of that original guideline. The patient information is not reviewed by NGC to establish whether or not it accurately reflects the original guideline's content.

NGC STATUS

This summary was completed by ECRI on September 1, 2001. The information was verified by the guideline developer as of November 19, 2001. This summary was updated by ECRI on December 19, 2006. The updated information was verified by the guideline developer on July 20, 2007.

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