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*Pediatrics* 2003;111;1416

# National Kidney Foundation's Kidney Disease Outcomes Quality Initiative Clinical Practice Guidelines for Chronic Kidney Disease in Children and Adolescents: Evaluation, Classification, and Stratification

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**ABSTRACT.** *Objectives.* **A series of new guidelines has been developed by the National Kidney Foundation's Kidney Disease Outcomes Quality Initiative to improve the detection and management of chronic kidney disease (CKD). In most instances of CKD, the earliest manifestations of the disorder may be identified by relatively simple tests. Unfortunately, CKD is often "underdiagnosed," in part because of the absence of a common definition of CKD and a classification of the stages in its progression. The Kidney Disease Outcomes Quality Initiative clinical practice guidelines for CKD evaluation, classification, and stratification provide a basis to remedy these deficits. The specific goals of the guidelines described in this review are to provide: 1) an overview of the clinical practice guidelines as they pertain to children and adolescents, 2) a simple classification of the stages of CKD, and 3) a practical approach to the laboratory assessment of kidney disease in children and adolescents.**

*Methods.* **The guidelines were developed as part of an evidence-based evaluation of CKD and its consequences in patients of all ages. The data that were used to generate the guidelines in this article were extracted from a structured analysis of articles that reported on children with CKD.**

*Results and Conclusions.* **This review presents the definition and 5-stage classification system of CKD developed by the work group assigned to develop the guidelines, and summarizes the major recommendations regarding the early detection of CKD. Major emphasis is placed on the identification of children and adolescents with CKD by measuring the protein-to-creatinine ratio in spot urine specimens and by estimating the glomerular filtration rate from serum creatinine using prediction equations.** *Pediatrics* **2003;111:1416–1421;** ***guidelines, chronic, kidney, children, classification.***

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Received for publication Oct 21, 2002; accepted Jan 6, 2003.

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ABBREVIATIONS. CKD, chronic kidney disease; K/DOQI, Kidney Disease Outcomes Quality Initiative; NKF, National Kidney Foundation; GFR, glomerular filtration rate.

Chronic kidney disease (CKD) is a serious public health problem, with national surveys showing a considerably higher prevalence than appreciated previously.[1,2] In the United States, there is a rising incidence of kidney failure among adults that is associated in many cases with poor outcomes and high cost.[3] The major health consequences of CKD include not only progression to kidney failure, but also an increased risk of cardiovascular disease.[4] Recent evidence indicates that these outcomes can be improved by early treatment.[5] In many patients, including children, the initial diagnosis of CKD can be made using simple tests during the early stages of disease. The use of one such test, the detection of proteinuria in "spot" urines, has been the subject of a previous report in this journal.[6]

Unfortunately, there is currently a lack of agreement on which tests should be done to evaluate kidney function in children and adolescents. There also has been no simple classification of the stages of CKD, which could provide a template for the institution of preventive measures. A standardized approach to the evaluation of children and adolescents to determine if they are at increased risk for CKD and their subsequent evaluation and management would be facilitated by such a classification. In February 2002, the Kidney Disease Outcomes Quality Initiative (K/DOQI) of the National Kidney Foundation (NKF) addressed this deficiency in a special supplement of the *American Journal of Kidney Diseases*. This publication provided detailed clinical practice guidelines on CKD in both children and adults.[7] Two of the goals of these guidelines were 1) definition of CKD and classification of its stages, and 2) evaluation of laboratory tests for the clinical detection of kidney disease.

The present article summarizes recommendations from the K/DOQI guidelines regarding the early detection of CKD as they apply to children and adolescents. We will consider an approach that is appropriate for children who appear to be free of any risk factors for CKD and how this should be modified for children who, by history, are at increased risk

for developing CKD. This information is important for pediatricians, family physicians, pediatric nephrologists and urologists, and other health care providers who have the opportunity to detect CKD in children and adolescents during its early stages, and with proper management to prevent or ameliorate its complications and retard its progression to kidney failure.

## METHODS

The CKD guidelines were developed by a multidisciplinary work group assembled by the NKF. The data were obtained via a systematic review and structured analysis of the literature based on the procedure outlined by the Agency for Healthcare Research and Quality.[8] Guidelines which addressed the definition, classification, and evaluation of CKD in children and adolescents provide the focus of this article. Guidelines that were restricted to adults with CKD are not included. Additional details of the Evidence Review Team and the methodology used in developing the guidelines have been published.[7]

### Guidelines

*Guideline 1. Definition and Stages of CKD*

Adverse outcomes of CKD can often be prevented or delayed through early detection and treatment. Earlier stages of CKD can be detected through routine laboratory measurements.

- The presence of CKD should be established, based on presence of kidney damage and level of kidney function (glomerular filtration rate [GFR]), irrespective of diagnosis.
- Among patients with CKD, the stage of disease should be assigned based on the level of kidney function, irrespective of diagnosis, according to the K/DOQI CKD classification (Table 1).

The Work Group defined CKD as the presence of kidney damage or GFR <60 mL/min/1.73 m$^2$ for 3 months or more, irrespective of diagnosis (Table 2). Kidney damage is usually identified by the presence of markers of disease that are present in blood, urine, or imaging studies, rather than by kidney biopsy. The CKD guidelines emphasize persistent proteinuria as a particularly important marker of kidney damage. The rationale for including individuals with normal GFRs is that substantial kidney damage often occurs before this pivotal component of kidney function declines, and that these individuals are at increased risk for adverse outcomes of CKD. The rationale for including individuals with GFR <60 mL/min/1.73 m$^2$ without any other evidence of kidney damage is that reduction in kidney function below this level represents loss of at least 50% of normal kidney function, a level at which the prevalence of complications of CKD begins to increase. The 5 different CKD stages shown in Table 1 generally correspond to both the severity and the nature of the expected complications of CKD. Kidney failure (CKD stage 5) is defined as either 1) GFR <15 mL/min/1.73 m$^2$, or 2) need for the initiation of kidney replacement therapy (dialysis or transplantation).

The decision to use the level of GFR as the primary focus in this guideline was made because GFR provides the best measure of overall kidney function. However, correct interpretation of GFR values in individual patients, especially children and adolescents, requires a clear understanding that the normal level of GFR varies according to age, gender, and body size. The normal GFR in young adults is ~120 to 130 mL/min/1.73 m$^2$, whereas the normal level of GFR is much lower than this in early infancy, even when corrected for body surface area, and subsequently increases in relationship to body size for up to 2 years.[9] Hence, the GFR ranges that are used to define the 5 CKD Stages in Table 1 apply only to children 2 years of age and above. The normal range of GFRs at different ages is given in Table 3.[9–11]

Although hypertension is not included in the definition and stages of CKD described herein, it should be noted that high blood pressure is a common consequence and may be a presenting sign of CKD in children and adolescents, and patients with CKD and high blood pressure are at higher risk of loss of kidney function and development of cardiovascular disease. Children and adolescents with high blood pressure should be carefully evaluated for the presence of CKD.

**TABLE 2.** Criteria for the Definition of CKD

A patient has CKD if either of the following criteria are present:
1. Kidney damage for ≥3 mo, as defined by structural or functional abnormalities of the kidney, with or without decreased GFR, manifested by 1 or more of the following features:
   - Abnormalities in the composition of the blood or urine
   - Abnormalities in imaging tests
   - Abnormalities on kidney biopsy
2. GFR <60 mL/min/1.73 m$^2$ for ≥3 mo, with or without the other signs of kidney damage described above.

*Guideline 2. Evaluation and Treatment*

The evaluation and treatment of patients with CKD requires understanding of separate but related concepts of diagnosis, comorbid conditions, severity of disease, complications of disease, and risks for loss of kidney function and cardiovascular disease.

- Patients with CKD should be evaluated to determine:
  1. Diagnosis (type of kidney disease)
  2. Comorbid conditions (such as hyperlipidemia)
  3. Severity, assessed by level of kidney function
  4. Complications, related to level of kidney function
  5. Risk for loss of kidney function
  6. Risk for cardiovascular disease
- Treatment of CKD should include:
  1. Specific therapy, based on diagnosis
  2. Evaluation and management of comorbid conditions
  3. Slowing the loss of kidney function
  4. Prevention and treatment of cardiovascular disease
  5. Prevention and treatment of complications of decreased kidney function (eg, hypertension, anemia, acidosis, growth failure)
  6. Preparation for kidney failure therapy
  7. Replacement of kidney function by dialysis and transplantation, if signs and symptoms of uremia are present
- A clinical action plan should be developed for each patient, based on the stage of disease as defined by the K/DOQI CKD classification.
- Review of medications should be performed at all visits for the following:
  1. Dosage adjustment based on level of kidney function
  2. Detection of potentially adverse effects on kidney function or complications of CKD

**TABLE 1.** NKF-K/DOQI Classification of the Stages of CKD

| Stage | GFR (mL/min/1.73 m$^2$) | Description | Action Plan* |
|---|---|---|---|
| 1 | ≥90 | Kidney damage with normal or increased GFR | Treat primary and comorbid conditions<br>Slow CKD progression, CVD risk reduction |
| 2 | 60–89 | Kidney damage with mild reduction of GFR | Estimate rate of progression of CKD |
| 3 | 30–59 | Moderate reduction of GFR | Evaluate and treat complications |
| 4 | 15–29 | Severe reduction of GFR | Prepare for kidney replacement therapy |
| 5 | <15 (or dialysis) | Kidney failure | Kidney replacement therapy |

CVD indicates cardiovascular disease.
* The actions that are listed in the more severe stages of CKD also include actions from less severe stages.

**TABLE 3.** Normal GFR in Children and Adolescents

| Age (Sex) | Mean GFR ± SD (mL/min/1.73 m$^2$) |
|---|---|
| 1 wk (males and females) | 41 ± 15 |
| 2–8 wk (males and females) | 66 ± 25 |
| >8 wk (males and females) | 96 ± 22 |
| 2–12 y (males and females) | 133 ± 27 |
| 13–21 y (males) | 140 ± 30 |
| 13–21 y (females) | 126 ± 22 |

SD indicates standard deviation.

3. Detection of drug interactions
4. Therapeutic drug monitoring, if possible

- Patients with CKD should be referred to a specialist for consultation and comanagement. Patients with GFR <30 mL/min/1.73 m$^2$ should be referred to a pediatric nephrologist.

Although referral of children with a GFR <30 mL/min/1.73 m$^2$ is essential to initiate the appropriate education regarding kidney replacement therapy, the members of the Pediatric Work Group recommend that all children with evidence of CKD, especially those with GFR <60 mL/min/1.73 m$^2$, be referred to a pediatric nephrologist for consultation regarding their evaluation and management.

Defining the patient's stage of CKD should facilitate construction of a clinical action plan to improve outcomes (Table 1). Specific treatment depends on diagnosis, and a thorough search for reversible causes of kidney disease should be conducted in each patient. The remainder of the action plan is based on the stage of kidney disease, irrespective of diagnosis. Specific diagnosis of kidney disease is based on pathology and etiology. Differential diagnosis is based on the patient's history, physical examination, and laboratory evaluation. However, definitive diagnosis can be difficult, sometimes requiring kidney biopsy.

### *Guideline 3. Individuals at Increased Risk of CKD*

Some individuals without kidney damage and with normal or elevated GFR are at increased risk for development of CKD.

- All individuals should be assessed, as part of routine health encounters, to determine if they are at increased risk of developing CKD, based on clinical and sociodemographic factors.
- Individuals at increased risk of developing CKD should undergo testing for markers of kidney damage and to estimate the level of GFR.
- Individuals found to have CKD should be evaluated and treated as specified in Guideline 2.
- Individuals at increased risk, but found not to have CKD, should be advised to follow a program of risk factor reduction, if appropriate, and undergo repeated periodic evaluations.

The prevalence of children and adolescents at increased risk for CKD has not been studied systematically. It is likely that the number of individuals at risk for CKD exceeds the number of patients known to have CKD. Pediatric patients who are at increased risk of developing CKD include those with disorders such as those shown in Table 4.

### *Guideline 4. Estimation of GFR*

Estimates of GFR are the best overall indices of the level of kidney function.

- In children and adolescents, the GFR should be estimated from prediction equations that take into account the serum creatinine concentration and the patient's height and gender.
- The serum creatinine concentration alone should not be used to assess the level of kidney function.
- Clinical laboratories should report an estimate of GFR using a prediction equation, in addition to reporting the serum creatinine measurement.
- Autoanalyzer manufacturers and clinical laboratories should calibrate serum creatinine assays using an international standard.
- Measurement of creatinine clearance using timed (for example, 24-hour) urine collections does not improve the estimate of GFR over that provided by prediction equations. A 24-hour urine sample may provide useful information for:

**TABLE 4.** Disorders That Increase the Risk of CKD

- Family history of polycystic kidney disease or other genetic kidney disease
- Small birth weight infants
- Children with a history of acute kidney failure resulting from perinatal hypoxemia or other acute insults to the kidneys
- Renal dysplasia or hypoplasia
- Urologic disorders—especially obstructive uropathies
- Vesicoureteral reflux associated with recurrent urinary tract infections and scars in the kidneys
- Prior history of acute nephritis or nephrotic syndrome
- Prior history of hemolytic uremic syndrome
- Prior history of Henoch-Schönlein Purpura
- Diabetes mellitus
- Systemic lupus erythematosus
- Prior history of hypertension, eg, from renal artery or renal vein thrombosis in the neonatal period

1. Estimation of GFR in individuals with exceptional dietary intake (vegetarian diet, creatine supplements) or muscle mass (amputation, malnutrition, muscle wasting)
2. Assessment of diet and nutritional status
3. Need to start dialysis

In clinical practice, GFR has usually been estimated from the creatinine clearance or serum creatinine concentration. However, the measurement of creatinine clearance requires collection of a timed urine sample, which is inconvenient and frequently inaccurate. The serum creatinine is affected by factors other than GFR, principally creatinine production, which is related to body size, especially muscle mass. This leads to considerable variability between children of different ages and a relatively wide range for serum creatinine in normal individuals. Indeed, in many patients the GFR must decline to approximately half the normal level before the serum creatinine rises above the upper limit of normal. Thus, it is difficult to accurately estimate the level of kidney function or to detect earlier stages of CKD using serum creatinine alone as the measure of kidney function.

The accuracy of an estimate of GFR from serum creatinine in pediatric patients can be improved by using prediction equations that take into account the patient's height, age, and gender. However, differences among clinical laboratories in creatinine calibration can account for errors in GFR estimates as high as 20%, which could be clinically significant in individuals with near normal serum creatinine concentrations. Of the various prediction formulas that have been developed, the Schwartz formulas[12–14] and the Counahan-Barratt formula[15] have gained widespread use (Table 5). The difference between the constants cited in the standard Schwartz formula[12] and the Counahan-Barratt formula (0.55 and 0.43, respectively) appears to be the result of different assays used to measure creatinine. A subsequent series of studies compared the Schwartz-predicted GFR versus measured GFR, thus allowing assessment of the accuracy of this equation in estimating GFR.[16–20] Most of these studies reported some differences between the estimated and measured GFR: the mean differences ranged from −0.4 to 10 mL/min/1.73 m$^2$, with standard deviations ranging from 2 to 20 mL/min/1.73 m$^2$. The data suggest that the overestimate of the Schwartz formula increases with decreasing GFR. Similar results were obtained in studies evaluating the Counahan-Barratt formula.[15,21,22]

Although somewhat imprecise, the Schwartz and Counahan-Barratt formulas for estimating GFR in children provide much more practical methods for estimating GFR than the cumbersome—and often inaccurate—methods that use 24-hour urine specimens. Although measuring 24-hour creatinine clearance to assess GFR is not more reliable than estimating GFR from these prediction equations, a 24-hour urine collection maybe useful in selected patients for measurement of total excretion of nitrogen, electrolytes, and other substances. However, the use of a 24-hour urine collection for the estimation of GFR has consistently been shown to be no more, and often less, reliable than prediction equations based on the serum creatinine.

In the future, we propose that laboratories which measure serum creatinine concentration in children should also calculate and report the estimated GFR using the equations described above. Calculations by the laboratory, requiring minimal clinical

**TABLE 5.** Estimation of GFR in Children Using Serum Creatinine and Height

| Author, Year (No. of Subjects) | Equation |
|---|---|
| Schwartz et al[12] ($N$ = 186) | $C_{Cr}\ (\text{mL/min/1.73 m}^2) = \dfrac{0.55 \times Height\ (cm)}{S_{Cr}\ (mg/dL)}$ |
| Counahan et al[15] ($N$ = 108) | $GFR\ (\text{mL/min/1.73 m}^2) = \dfrac{0.43 \times Height\ (cm)}{S_{Cr}\ (mg/dL)}$ |

$C_{Cr}$ indicates creatinine clearance; $S_{Cr}$, serum creatinine.
In the Schwartz equation, the constant to be used in young children (<1 year of age) is 0.45,[13] in adolescent boys the value of the constant changes to 0.7.[14] To convert serum creatinine in μmol/L to mg/dL, the value in umol/L is multiplied by 0.0113.

information, would be much more reliable and clinically pertinent than requiring the formulas to be used by individual physicians. In order for this to be conducted efficiently, clinical laboratories will need to resolve how to obtain the additional information required for the prediction equation (ie, patient height) and what additional information to include on the report, such as normal values for age and gender and GFR levels for K/DOQI CKD stages.

We are also hopeful that further research will be done to develop more accurate, yet still simple, methods to estimate GFR. Although the use of prediction equations allows a physician to have a somewhat better understanding of a patient's GFR, it must be acknowledged that the use of serum creatinine as the basis for these equations is problematic because of the different assays used to measure serum creatinine, the lack of calibration among laboratories, and the relatively low precision of the test itself.[23]

### *Guideline 5. Assessment of Proteinuria*

Normal individuals usually excrete very small amounts of protein in the urine. Persistently increased protein excretion is usually a marker of kidney damage. The excretion of specific types of protein, such as albumin or low molecular weight globulins, depends on the type of kidney disease that is present. Increased excretion of albumin is a sensitive marker for CKD attributed to diabetes, glomerular disease, and hypertension. Increased excretion of low molecular weight globulins is a sensitive marker for some types of tubulointerstitial disease. In this guideline, the term "proteinuria" refers to increased urinary excretion of albumin, other specific proteins, or total protein; "albuminuria" refers specifically to increased urinary excretion of albumin. "Microalbuminuria" refers to albumin excretion above the normal range but below the level of detection by dipstick for total protein.

- Under most circumstances, untimed ("spot") urine samples should be used to detect and monitor proteinuria in children and adolescents.
- It is usually not necessary to obtain a timed urine collection (overnight or 24-hour) for these evaluations.
- First morning specimens are preferred, but random specimens are acceptable if first morning specimens are not available.
- In most cases, screening with urine dipsticks is acceptable for detecting proteinuria:
  1. Standard urine dipsticks are acceptable for detecting increased total urine protein.
  2. Albumin-specific dipsticks are acceptable for detecting albuminuria.
  3. Patients with a positive dipstick test (1+ or greater) should undergo confirmation of proteinuria by a quantitative measurement (protein-to-creatinine ratio or albumin-to-creatinine ratio) within 3 months.
- Patients with 2 or more positive quantitative tests temporally separated by 1 to 2 weeks should be diagnosed as having persistent proteinuria and undergo further evaluation.[6]

*Specific Guidelines for Children Without Diabetes:*

- When screening children for CKD, total urine protein should be measured in a spot urine sample using either:
  1. Standard urine dipstick
  2. Total protein-to-creatinine ratio
- Orthostatic proteinuria must be excluded by repeat measurement on a first morning specimen if the initial finding of proteinuria was obtained on a random specimen.
- When monitoring proteinuria in children with CKD, the total protein-to-creatinine ratio should be measured in spot urine specimens.

*Specific Guidelines for Children With Diabetes:*

- When screening postpubertal children with diabetes of 5 or more years of duration, albumin should be measured in a spot urine sample using either:
  1. Albumin–specific dipstick
  2. Albumin-to-creatinine ratio
- Screening and monitoring other children with diabetes should follow the guidelines for children without diabetes.

The method most often used for detecting proteinuria in the physician's office is the urinary dipstick, which primarily detects albumin, leaving low molecular weight proteins undetected. A color reaction between urinary albumin and tetrabromphenol blue produces various green hues depending on the concentration of albumin in the sample. In contrast, when clinical laboratories measure "total protein" the assay detects both low and high molecular weight globulins—in addition to albumin.

Measurement of protein excretion in a 24-hour collection has long been the "gold standard" for the quantitative evaluation of proteinuria. An alternative method is measurement of the ratio of protein or albumin to creatinine in an untimed "spot" urine specimen (Table 6).[6] These ratios correct for variations in urinary protein concentration attributed to hydration and are more convenient than timed urine collections. A number of studies have demonstrated that the ratio of protein to creatinine in a spot urine sample provides an accurate estimate of the protein excretion rate.[24–30] Similar results have usually been obtained when urine albumin to creatinine ratios have been compared with albumin excretion rates.[31–36] Under most circumstances, spot urine samples—rather than timed collections—should be used to detect and monitor proteinuria in children and adolescents. The ("spot") urine specimen that is preferred is a first morning urine specimen, because urine protein concentrations can vary significantly during the day. The prevalence of proteinuria in normal children is between 5% and 15% in large-scale screening studies when only a single random urine specimen has been tested. The finding of persistent proteinuria on repeat urine testing in such studies is much less common. Most children who have proteinuria that does not persist on repeated testing may be considered to have transient proteinuria, a benign condition that is often associated with fever, stress, or exercise.

Orthostatic proteinuria is a condition that may be defined as protein excretion that is abnormally high only when the subject is upright. This usually persists when the test is conducted on repeat urines, provided the patient is ambulatory. It occurs most commonly in school-aged children and often results in urine Pr/Cr ratios of 0.5 to 1.0. Follow-up studies have shown that orthostatic proteinuria is benign in almost all individuals. Patients with this condition do not require specific treatment. Further details about the evaluation of children with orthostatic proteinuria were published previously.[6]

A measurement that has assumed increasing importance in assessing pediatric patients with diabetic nephropathy is the determination of microalbuminuria. Many laboratories now offer convenient and sensitive assays for low-to-moderate amounts of albuminuria (usually reported as milligrams of albumin per gram of creatinine). Primary care physicians should note that "microalbuminuria" is really a misnomer. The test measures "ordi-

**TABLE 6.** Comparison of UPr/Cr and UAlb/Cr Ratios in Children and Adolescents

| | UPr/Cr (mg/mg) | UAlb/Cr (mg/g or μg/mg) |
|---|---|---|
| Indication | Semiquantitative assessment of proteinuria in children with positive dipstick for protein | Assess risk of CKD in postpubertal patients with diabetes mellitus of >5 y |
| Normal range | <0.2 in children 2 y of age or older<br><0.5 in children 6–24 mo of age | <30 on first morning urine specimen |
| Comments | Simplest method to quantitate proteinuria. Positive result also found in children with low molecular weight proteinuria | Therapy should be intensified in diabetics with microalbuminuria to prevent progressive CKD |

nary" albumin, but its high sensitivity and ability to detect very small quantities of albumin led to the term microalbuminuria.

*Guideline 6. Markers of CKD Other Than Proteinuria*

Markers of kidney damage other than proteinuria include abnormalities in the urine sediment and abnormalities on imaging studies. Constellations of markers define clinical presentations for some types of CKD. New markers are needed to detect kidney damage that occurs before a reduction in GFR in other types of CKD.

- Urine sediment examination or dipstick for red blood cells and white blood cells should be performed in patients with CKD and in individuals at increased risk of developing CKD.
- Imaging studies of the kidneys should be performed in patients with CKD and in selected individuals at increased risk of developing CKD.
- Although several novel urinary markers (such as tubular or low-molecular weight proteins and specific mononuclear cells) show promise of future utility, they are usually not required for clinical decision-making at present.

The results of urine sediment examination, imaging studies of the kidney, and selected clinical presentations can suggest various types of CKD, including glomerular, vascular, tubulointerstitial, and cystic diseases of the kidney. Microscopic examination of the urinary sediment, especially in conjunction with assessment of proteinuria, is useful in the detection of CKD and in the identification of the type of kidney disease. Urine dipsticks include reagent pads that are sensitive for the detection of red blood cells (hemoglobin), neutrophils and eosinophils (leukocyte esterase), and bacteria (nitrites). However, dipsticks cannot detect tubular epithelial cells, fat, or casts in the urine. In addition, urine dipsticks cannot detect crystals, fungi, or parasites. The choice of urine sediment examination versus dipstick depends on the type of kidney disease that is being considered.

Abnormal results on imaging studies may suggest vascular, urologic, or intrinsic kidney diseases. Imaging studies are recommended in most patients with known CKD and in patients at increased risk of developing CKD attributable to the conditions listed in Table 4. Ultrasound examination is particularly useful for several of these conditions, and it is not associated with risk of exposure to radiation or contrast. More invasive procedures, such as voiding cystourography and kidney biopsy, may be appropriate in selected cases. Some clinical presentations of CKD are suggested by characteristic abnormalities in the blood, such as renal tubular acidosis or nephrogenic diabetes insipidus. More detailed description of abnormalities on urinalysis, imaging studies, and clinical presentations of CKD are discussed in the full CKD guidelines.[7]

## CONCLUSIONS

The material presented in this review provides practical guidance for the evaluation of kidney function by health care providers who encounter children and adolescents in their practices. There is now convincing evidence that the relatively simple tests described represent powerful tools in the early identification of CKD. The K/DOQI guidelines were developed to be consistent with those already published by other health care organizations such as the American Diabetes Association[37] and the American Academy of Pediatrics.[38] The American Academy of Pediatrics recommends that urine screening tests be conducted on 2 occasions during childhood—once before starting school and then again during adolescence. We concur with this recommendation. Integration of the K/DOQI guidelines into clinical practice will provide a means of early identification, and therefore potentially successful intervention, for many individuals with CKD who would otherwise be destined to present later with serious sequelae of untreated kidney failure. Further details about the K/DOQI-CKD guidelines can be obtained at www.kdoqi.org.

## ACKNOWLEDGMENTS

This work was supported in part by the National Kidney Foundation.

The authors wish to express their appreciation to Marva Moxey-Mims, MD, FAAP, Director of the Pediatric Nephrology Program, National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases, Division of Kidney, Urologic, and Hematologic Diseases and Ann Guillot, MD, Director of the Nephrology Section of the American Academy of Pediatrics for their thoughtful review and comments in the development of this manuscript. The authors also wish to thank Dana Parrott for her excellent assistance in the preparation of the manuscript. In addition, the authors acknowledge the important contributions of other members of the CKD Work Group and Evidence Review Team, K/DOQI Support Group and Advisory Board, and the National Kidney Foundation.

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## LIFEBLOOD OF SCIENCE

"Controversies are an integral part of the collective production of knowledge; disagreements on concepts, methods, interpretations, and applications are the lifeblood of science and one of the most productive factors in scientific development."

Controversies in science: remarks on the different modes of production of knowledge and their use. *Ztschr Sociol.* 1975;4:37

Submitted by Student

# National Kidney Foundation's Kidney Disease Outcomes Quality Initiative Clinical Practice Guidelines for Chronic Kidney Disease in Children and Adolescents: Evaluation, Classification, and Stratification

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*Pediatrics* 2003;111;1416