

## SPECIAL ARTICLE

# Comprehensive Public Health Strategies for Preventing the Development, Progression, and Complications of CKD: Report of an Expert Panel Convened by the Centers for Disease Control and Prevention

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Chronic kidney disease (CKD) is a public health threat in the United States, with increasing prevalence, high costs, and poor outcomes. More widespread effort at the prevention, early detection, evaluation, and management of CKD and antecedent conditions could prevent complications of decreased kidney function, slow the progression of kidney disease to kidney failure, and reduce cardiovascular disease risk. In 2006, the Centers for Disease Control and Prevention (CDC) launched an initiative on CKD. As part of this initiative, the CDC convened an expert panel to outline recommendations for a comprehensive public health strategy to prevent the development, progression, and complications of CKD in the United States. The panel adapted strategies for primary, secondary, and tertiary prevention for chronic diseases to the conceptual model for the development, progression, and complications of CKD; reviewed epidemiological data from US federal agencies; and discussed ways of integrating public health efforts from various agencies and organizations. The panel recommended a 10-point plan to the CDC to improve surveillance, screening, education, and awareness directed at 3 target populations: people with CKD or at increased risk of developing CKD; providers, hospitals, and clinical laboratories; and the general public. Cooperation among federal, state, and local governmental and private organizations will be necessary to carry out these recommendations.

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**INDEX WORDS:** Chronic kidney disease; prevention; public health.

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Chronic kidney disease (CKD) is a growing public health threat in the United States, with an increasing prevalence of kidney failure and earlier stages of CKD, high costs, and poor outcomes.<sup>1-4</sup> CKD is one of a number of chronic diseases affecting primarily the elderly

and leading to substantially increased risk of cardiovascular disease (CVD), with a disproportionate burden in racial and ethnic minorities. As with hypertension, diabetes, and hypercholesterolemia, CKD is silent in its early stages, but can be detected from simple clinical and laboratory measurements. Treatment now is available to prevent complications of decreased kidney function, slow the progression of kidney disease, and reduce CVD risk.<sup>2</sup> CKD testing can detect earlier stages of CKD, and the same methods used in clinical practice can be used to screen populations at increased risk.<sup>5</sup> Public health interventions are available to improve the treatment and prevent the development of hypertension and diabetes, the 2 most common causes of CKD in adults.<sup>6,7</sup> Thus, the tools to reduce the burden of CKD are already available, but a comprehensive public health approach has not yet been developed.

Physician organizations in the United States have recognized the need to improve care for patients with kidney failure and earlier stages of

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CKD.<sup>8,9</sup> In 2006, the Centers for Disease Control and Prevention (CDC), as requested by Congress, launched an initiative on CKD.<sup>10</sup> As part of this initiative, the CDC convened an expert panel meeting to outline recommendations for comprehensive public health strategies to prevent the development, progression, and complications of CKD in the United States. This report summarizes the findings of the panel from its meeting in March 2007 and its recommendations to the CDC.

**THE PUBLIC HEALTH THREAT FROM CKD**

The incidence, prevalence, mortality, and cost for patients with kidney failure treated by dialysis and transplantation, the end stage of CKD, have increased steadily during the past 2 decades and are projected to continue to increase through 2020 (Table 1).<sup>11</sup> The recent stabilization of incidence rates of treated kidney failure is encouraging, but appears to reflect a mixture of several trends.<sup>12</sup> First, the increase in age and comorbidity of patients initiating dialysis therapy during the past decade suggests that part of the prior increase in incidence may have been caused by increases in treatment, in addition to increases in kidney failure. Possibly, the stabilization of incidence rates in some groups reflects stabilization in treatment. Second, the decrease in incidence rate in some groups, such as in young white people with diabetes mellitus, strongly suggests delay in kidney failure because of improvements in the treatment of patients with earlier stages of

disease in this high-risk group. The continuing increase in incidence rate in the elderly and racial and ethnic minorities may represent important disparities in health care. Incidence rates for African Americans and Native Americans are nearly 3 and 2 times greater than for whites, respectively. Incidence rates for people older than 65 years are nearly 3 times greater than for younger people (Fig 1).<sup>2,11</sup>

There is more than a 50-fold greater prevalence of patients with earlier stages of CKD, defined as albuminuria or decreased estimated glomerular filtration rate (GFR), compared with patients with treated kidney failure.<sup>13</sup> Approximately 13% of the noninstitutionalized US adult population is now estimated to have CKD (26 million individuals), an increase from 10% almost 10 years earlier.<sup>13,14</sup> The increase is greatest in the elderly and appears to be caused in part by an increasing prevalence of diabetes and hypertension.

Altogether, these findings have dramatic potential consequences for the burden of CKD. First, the age-related decrease in GFR, long considered a “normal” part of aging, is associated with complications, increased risk of adverse outcomes, and high costs. Second, the aging of the population portends continuing increases in the number of cases of CKD, even if the incidence rate remains stable. Third, the increasing prevalence of obesity may lead to an earlier age of onset of hypertension and diabetes that could lead to an increasing incidence rate of kidney

**Table 1. Kidney Failure in the United States**

	2005 Estimates		2020 Projections
Mortality	85,000	Death rate was 7 times greater in persons ≥ 65 y treated by dialysis than in those in the general Medicare population	125,000*
Incidence	105,000	Most cases caused by diabetes (44%) or hypertension (27%)	151,000†
Prevalence	478,000	Including > 335,000 living on dialysis therapy and > 141,000 with a kidney transplant	785,000
Costs	\$20 billion	Total Medicare expenditures for ESRD represented > 6% of total Medicare budget	\$54 billion

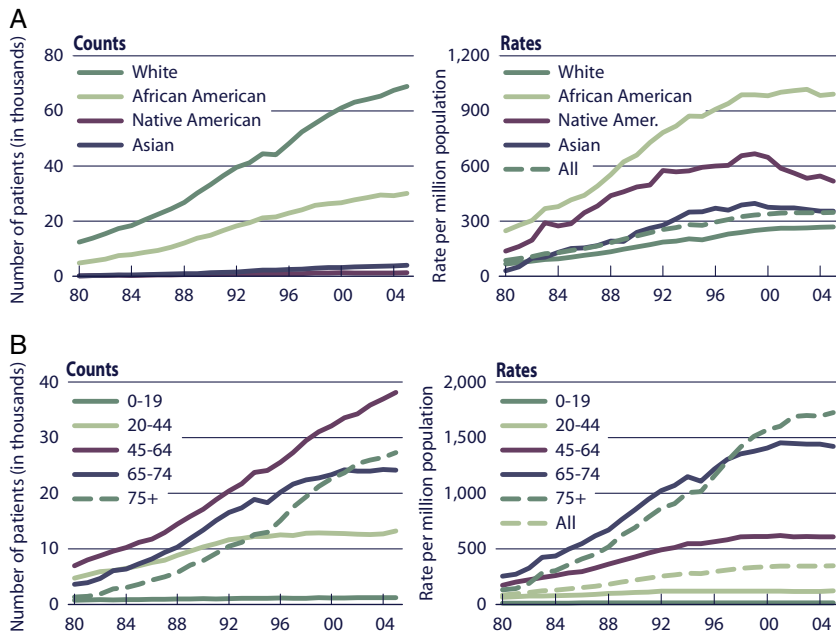
Note: Data represent patients treated by dialysis and transplantation. Costs refer to total Medicare expenditures (2005 dollars).

Abbreviations: ESRD, end-stage renal disease; USRDS, US Renal Data System.

Data from USRDS.<sup>11</sup>

\*Personal communication from David T. Gilbertson, PhD, Chronic Disease Research Group, USRDS Coordinating Center, August 21, 2007.

†Based on Markov models. Projection based on autoregression models is 144,000 incident cases in 2020.



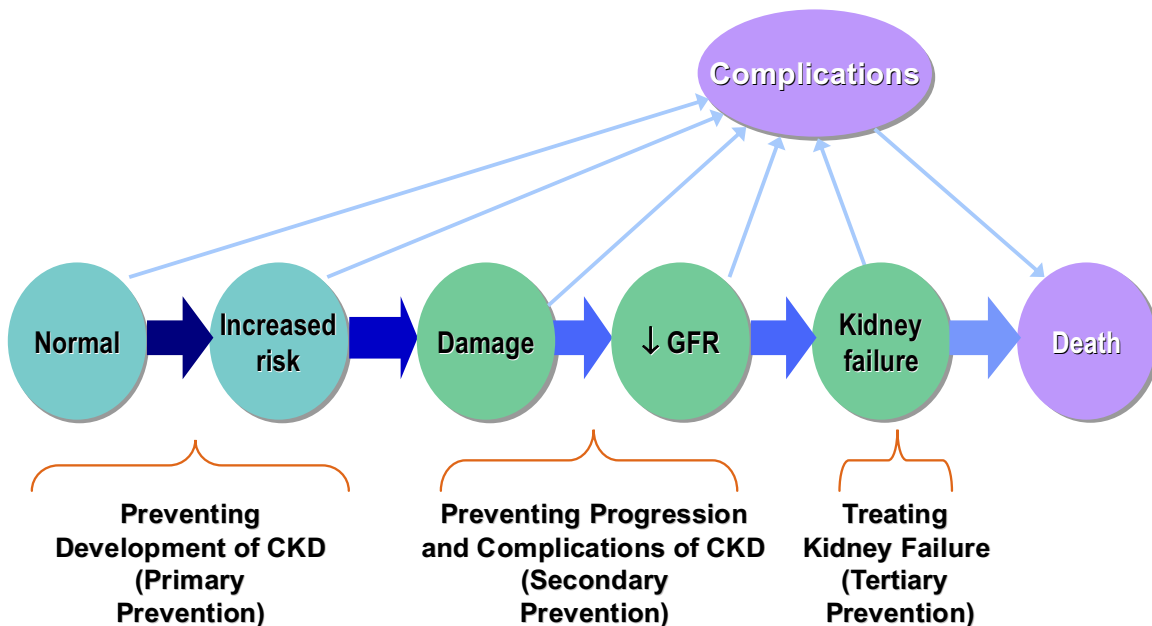
**Figure 1.** Trends in treated kidney failure by race and age. Incidence counts and rates for kidney failure treated by dialysis and transplantation (A) by race, adjusted for age and sex, and (B) by age, adjusted for race and sex. Reproduced with permission from the 2007 Annual Data Report of the US Renal Data System.<sup>11</sup>

failure and CVD. Fourth, mounting costs for dialysis and transplantation are occurring at the same time that costs for other chronic diseases are increasing. The care of patients with chronic diseases consumes a large fraction of health care resources.<sup>15</sup> The epidemic of obesity is expected to magnify these costs.

These findings are not unique to the United States. Throughout the world, chronic noncommunicable diseases are increasingly recognized as a public health threat.<sup>16</sup> Prevalence estimates for treated kidney failure vary widely, in part because of limited availability of dialysis and transplantation. In Japan, Taiwan, and Thailand, where dialysis and transplantation are paid for by the government, the prevalence of treated kidney failure is as high as in the United States.<sup>17</sup> The prevalence of earlier stages of kidney disease in developed countries within Europe, Asia, and Australia also appears similar to that observed in the United States.<sup>18-20</sup> Accurate data for developing countries are not available. Developing countries are now experiencing the burden of noncommunicable chronic diseases, although communicable chronic diseases are not yet under control. For all countries, prevention, early detection, and intervention would be more cost-effective than treatment for kidney failure.

## THE PANEL AND ITS REVIEW

The panel co-chairs were selected by the CDC, and other members were invited because of their knowledge of epidemiology, clinical practice guidelines, and current initiatives on screening and surveillance for CKD in the United States. The panel adapted preventive strategies for chronic diseases to the conceptual model for the development, progression, and complications of CKD; reviewed epidemiological data from US federal agencies; and discussed ways of integrating public health efforts for the prevention, detection, evaluation, and management of CKD. The recommendations were developed during the panel's 2-day meeting in March 2007, in which representatives from federal agencies and US voluntary health organizations were invited to participate. The agenda and a roster of participants are available at the CDC website.<sup>21</sup> The report was prepared by the authors, with review and approval by all members of the expert panel and by the CDC. Figure 2 shows a conceptual model for CKD and its relationship to the classification of preventive strategies.<sup>2-4,22,23</sup> Table 2 links these preventive strategies with clinical and epidemiological features of CKD and US clinical practice guidelines.<sup>2,6,7,11,14,24-46</sup> Guidelines were searched through MEDLINE under "guidelines prevention treatment (chronic kidney



**Figure 2.** Conceptual model of the public health approach for chronic kidney disease (CKD). Green circles, stages of CKD; blue circles, potential antecedents or consequences of CKD; thick arrows between circles, risk factors associated with the initiation and progression of disease that can be affected or detected by interventions; purple circles, outcomes of CKD. “Complications” refers to all complications of CKD and its treatment, including complications of decreased glomerular filtration rate (hypertension, anemia, malnutrition, and bone and mineral disease) and cardiovascular disease. Preventive strategies are shown below the target populations and risk factors to which they apply. Primary, secondary, and tertiary prevention refer to CKD. Modified and reprinted with permission.<sup>2</sup>

disease)” and through the National Guideline Clearinghouse under “chronic kidney disease.” Table 3 lists existing programs for public health efforts for CKD.<sup>11,13,14,25,47-68</sup>

### CONCEPTUAL FRAMEWORK AND TESTING FOR CKD

Figure 2 shows the chronic disease model for CKD, emphasizing stages of CKD and antecedents, outcomes, and risk factors for the development, progression, and complications of CKD.<sup>2-4,22,23</sup> CKD is defined as either kidney damage or GFR less than 60 mL/min/1.73 m<sup>2</sup> for 3 months or longer, regardless of the cause of kidney disease.<sup>2-4</sup> The most common markers of kidney damage include abnormalities in urine, such as albuminuria (usually ascertained as a spot urine albumin-creatinine ratio > 30 mg/g), abnormalities in kidney imaging results, or a history of kidney transplantation. GFR usually is estimated from an equation using serum creatinine level, age, sex, and race.<sup>5,68,69</sup> Stages of CKD are defined by level of GFR.

CKD is a heterogeneous condition, varying according to the cause and type (pathology) of kidney disease, severity, rate of progression, and comorbid conditions. Typically, CKD evolves over a long time, during which the disease can be detected by means of laboratory tests before the onset of symptomatic kidney failure. In the majority of patients, CKD can be detected by using 2 simple tests: a urine test for albumin and a blood test for serum creatinine to estimate GFR.<sup>5</sup> Because of the lesser accuracy of estimating equations at higher levels of GFR, GFR estimates greater than 60 mL/min/1.73 m<sup>2</sup> are not reported as a numeric value by clinical laboratories, and it may be difficult to interpret GFR estimates just less than 60 mL/min/1.73 m<sup>2</sup> in some people.<sup>70</sup> In this range, interpretation of GFR estimates depends on results of tests for markers of kidney damage and the clinical context. Restricting routine testing to patients at increased risk of CKD reduces false-positive results and enables more efficient use of resources.

**Table 2. Description, Prevalence Estimates, Public Health Strategies, and Clinical Guidelines for CKD and Antecedent Conditions**

Preventive Strategies†	CKD Stage or Antecedent Conditions	Description	GFR (mL/min/1.73 m <sup>2</sup> )	Prevalence* N [1,000s] (%)	Related Terms and ICD-9 Codes	Public Health Strategies and Clinical Guidelines
Primary prevention	Antecedent conditions	At increased risk	NA		CKD risk factors	Glycemic and blood pressure control <sup>6,7</sup> ; ACE inhibitor/ARB use <sup>24</sup> ; CKD awareness and education <sup>2,25-27</sup> , especially in patients at increased risk
		Age ≥ 60 y		50,600 (23.2)		
		Hypertension		65,000 (32.3)		
		Diabetes		20,600 (9.6)		
		CVD		71,300 (34.2)		
Family history of CKD		National data not available				
Secondary prevention	CKD stage 1	Kidney damage with normal or ↑ GFR	≥90	3,600 (1.78)	Albuminuria, proteinuria, hematuria; 585.1	CKD education and testing for patients at increased risk <sup>24,25,28</sup> ; glycemic and blood pressure control <sup>6,7,30</sup> ; ACE inhibitor/ARB use <sup>6,7,26,27,29</sup> ; other treatments to slow CKD progression <sup>2</sup> ; counseling on nutrition <sup>30</sup> ; evaluation and control of dyslipidemia <sup>31</sup> and other CVD risk factors <sup>2</sup> ; treatment of hepatitis C <sup>32</sup> ; follow recommended clinical guidelines <sup>2</sup>
	CKD stage 2	Kidney damage with mild ↓ GFR	60-89	6,500 (3.24)	Albuminuria, proteinuria, hematuria; 585.2	
	CKD stage 3	Moderate ↓ GFR	30-59	15,500 (7.69)	Chronic renal insufficiency, early renal insufficiency; 585.3	
	CKD stage 4	Severe ↓ GFR	15-29	700 (0.35)	Chronic renal insufficiency, late renal insufficiency, pre-ESRD; 585.4	
Tertiary prevention	CKD stage 5	Kidney failure	<15 (or dialysis)	400 (0.20)	Renal failure, uremia, ESRD; 585.5, 585.6 (if ESRD), V codes for dialysis or transplantation	Dialysis adequacy <sup>38,39</sup> , vascular access <sup>37</sup> , anemia <sup>33</sup> , CVD <sup>40</sup> , nutrition <sup>30</sup> , bone metabolism <sup>34</sup> ; evaluation for transplantation <sup>41</sup> ; and initiation and withdrawal from dialysis <sup>42</sup> ; follow recommended clinical guidelines <sup>2</sup>

Note: Conversion factor: GFR in mL/min/1.73 m<sup>2</sup> to mL/s/1.73 m<sup>2</sup>, ×0.01667.

Abbreviations: ACE, angiotensin-converting enzyme; ARB, angiotensin receptor blocker; CKD, chronic kidney disease; CVD, cardiovascular disease; ESRD, end-stage renal disease; GFR, glomerular filtration rate; ICD-9, *International Classification of Diseases, Ninth Revision*; NA, not applicable; NHANES, National Health and Nutrition Examination Survey.

\*Prevalence estimates for antecedent conditions based on data in people 20 years or older.<sup>43-45</sup> Prevalence for CKD stages 1 to 4 is projected from the NHANES (1999-2004) for the population of 200 million adults aged 20 years or older in 2000.<sup>14</sup> Prevalence for CKD stage 5 is based on 300,000 patients treated by dialysis in 2001 to 2002<sup>11</sup> and an assumed additional 100,000 not treated by dialysis.<sup>46</sup>

†Primary prevention is directed at people at increased risk of CKD; secondary prevention, at patients with CKD stages 1 to 4, divided into 2 groups based on CKD stages 1 to 2 (kidney damage) and stages 3 to 4 (decreased GFR); and tertiary prevention, at patients with kidney failure, including those treated by dialysis and transplantation.

**Table 3. Existing Programs for Surveillance, Screening, and Education and Awareness for CKD in the United States**

Program (Funding)	Description
<b>Surveillance</b>	
USRDS <sup>11,47-49</sup> (NIDDK and CMS)	USRDS collects, analyzes, and distributes information about patients with kidney failure treated by dialysis or transplantation (ESRD). USRDS also analyzes a random sample of the Medicare population with claims for kidney disease, usually applied to CKD stage 4. These and related Medicare claims data have been essential in describing the growing burden of ESRD on the US population and the pattern of inadequate care of patients with CKD at the inception of ESRD therapy.
NHANES <sup>13,14,50,51</sup> (CDC and conducted by CDC NCHS)	NHANES is currently a continuous survey of the health and nutritional status of the US civilian noninstitutionalized population. NHANES provides surveillance data about the prevalence and incidence of earlier stages of CKD, awareness of disease status in individuals with CKD, and patterns of associated risk factors.
ESRD Network System <sup>52-58</sup> (CMS)	The ESRD Network System consists of 18 regional networks that use information about patient and treatment center care to improve treatment and outcomes of ESRD care. The success of these efforts is due in part to the incorporation of performance measures derived from clinical practice guidelines in quality improvement activities.
QIO <sup>59-64</sup> (CMS)	QIO is a state-based system managed by the same CMS teams responsible for the ESRD Networks. One early focus for the QIOs was improving the primary care of patients with diabetes mellitus and diabetic kidney disease. These efforts have resulted in evidence of poor detection and management of diabetic kidney disease in Medicare beneficiaries.
<b>Screening</b>	
KEEP <sup>25,65</sup> (NKF)	KEEP targets populations at high risk of CKD, including individuals with diabetes mellitus, hypertension, or a first-degree relative with diabetes mellitus, hypertension, or kidney disease. Screening tests include blood pressure, plasma glucose, serum creatinine, hemoglobin, and urine tests for albumin-creatinine ratio and pyuria. For screen-positive individuals, KEEP provides physician consultation and referral, as well as postscreening follow-up. KEEP also performs assessment of outcomes of care in a cohort of screen-positive individuals.
<b>Education and awareness</b>	
NKDPEP <sup>66-68</sup> (NIDDK)	NKDPEP activities include maintenance of a clearinghouse for relevant publications, development and distribution of materials to support family-based activities for prevention and detection of CKD, and a sustained effort to promote improved care for patients with CKD through GFR reporting using standardized creatinine measurements by clinical laboratories.

Abbreviations: CDC, Centers for Disease Control and Prevention; CKD, chronic kidney disease; CMS, Centers for Medicaid & Medicare Services; ESRD, end-stage renal disease; KEEP, Kidney Early Evaluation Program; NCHS, National Center for Health Statistics; NHANES, National Health and Nutrition Examination Survey; NIDDK, National Institute of Diabetes and Digestive and Kidney Diseases; NKDEP, National Kidney Disease Education Program; NKF, National Kidney Foundation; QIO, Quality Improvement Organizations; USRDS, US Renal Data System.

**CONTINUUM OF DISEASE PREVENTION**

Strategies for disease prevention may be divided into primary, secondary, and tertiary according to the presence or absence of disease and its severity. The panel applied these strategies to CKD. Table 2 links these preventive strategies with additional clinical description of stages of

CKD and antecedent conditions, recent prevalence estimates, and US clinical practice guidelines.<sup>2,6,7,11,14,24-46</sup>

**Primary Prevention**

Primary prevention includes preventing the development of risk factors for CKD, such as

hypertension and diabetes, and preventing the development of CKD in populations at increased risk. Recent trials have shown that lifestyle modification can reduce the incidence of diabetes in high-risk individuals,<sup>7</sup> and reductions in dietary salt intake can decrease blood pressure and reduce the incidence of hypertension.<sup>6</sup> Several studies have shown the potential to prevent or delay the development of albuminuria in patients with diabetes by using strict glucose control or an angiotensin-converting enzyme inhibitor.<sup>24,71-73</sup> Primary prevention strategies have not yet been proved for CKD caused by hypertension or other causes of CKD.

### Secondary Prevention

Secondary prevention includes slowing the progression and treating complications in patients with kidney damage (stages 1 to 2) and decreased GFR (stages 3 to 4).<sup>2</sup> In patients with stages 1 to 2, in which GFR is normal or only mildly impaired, interventions include evaluation, treatment of the underlying cause of kidney disease, and general measures to slow kidney disease progression and reduce CVD risk. In patients with stages 3 to 5, in which GFR is moderately to severely impaired, additional interventions are necessary for complications of decreased GFR, such as hypertension, anemia, malnutrition, and bone and mineral disorders. The knowledge and practice of the detection, treatment, and control of CKD and associated risk factors for progression in US populations is substantially less than optimal.<sup>47,74-77</sup> The key to effective secondary prevention is the early identification and treatment of CKD in those at increased risk. The panel considered 3 main risk groups: patients with hypertension or diabetes, patients with CVD, and people with a family history of CKD.

#### *Hypertension and Diabetes*

Clinical trials have shown the efficacy of therapies to slow the progression of CKD caused by hypertension and diabetes.<sup>6,7,26,27,29</sup> The benefits of treating patients with early kidney disease may include CVD risk reduction.<sup>78,79</sup> There are no data from large clinical trials to assess the efficacy of screening; however, cost-effectiveness analyses suggest benefit for patients with

diabetes<sup>80-82</sup> or patients with hypertension aged 60 years or older.<sup>83</sup>

#### *Cardiovascular Disease*

Recent data show CVD as a risk factor for loss of kidney function and development of CKD.<sup>84,85</sup> Guidelines now recommend testing for CKD in patients with CVD risk factors or clinical CVD.<sup>28</sup> The rationale for screening patients with CVD and CVD risk factors is that the prevalence of CKD is greater in these groups. Moreover, in the "CKD subgroup," CVD risk factor levels are greater and more difficult to control, outcomes are worse, costs are higher, and strategies for CVD risk reduction and treatment differ in patients with compared with those without CKD.<sup>86,87</sup> Some have referred to CKD as a "multiplier" for CVD risk.<sup>88,89</sup> As with all CVD risk factors, the increase in absolute risk is greater in people with other risk factors. Many clinical trials of patients with CVD risk reduction or treatment excluded patients with later stages of CKD<sup>90</sup>; however, analyses of trials that included patients with earlier stages of CKD generally showed that the beneficial effect of treatment in the CKD subgroup is as large as or larger than in the group without CKD.<sup>91-93</sup>

#### *Family History*

There is substantial evidence that members of families with an index member with kidney failure are at increased risk of kidney failure.<sup>94</sup> Individuals who report a family member with kidney failure have an increased prevalence of hypertension, diabetes, and earlier stages of CKD.<sup>95</sup> A recent population-based study of older US adults found a high prevalence of family history of kidney failure and that these individuals were more likely to be African American and women, have a history of diabetes, and be overweight or obese.<sup>96</sup>

#### *Tertiary Prevention*

Tertiary prevention includes improving care for patients with kidney failure. Clinical practice guidelines have been developed for many aspects of care,<sup>30,33,36-39,41</sup> and recent data show an association between achievement of clinical performance measures based on these guidelines and improved survival.<sup>97</sup>

**Table 4. Recommendations of the Expert Panel to the CDC**

Recommendation	Rationale for Recommendation	Action	Examples of Existing Programs or Systems	
Target: people with CKD or at increased risk of CKD				
1	Define national goals for improving CKD outcomes	Increased salience of CKD as public health issue	(1.1) Include CKD goals in Healthy People 2020	Healthy People
2	Implement existing quality improvement measures	Extend focus of national Medicare quality improvement activities to include CKD	(2.1) Include CKD in 2009 statement of work for CMS QIOs (2.2) Recommend use of existing clinical performance measures for CKD, such as proteinuria and hemoglobin A <sub>1c</sub> testing	QIOs (CMS)
3	Define new quality improvement measures	Establish CKD quality measures applicable for managed care populations	(3.1) Use DQIP measures (3.2) Evaluate other quality improvement data sets	HEDIS (NCQA)
4	Implement surveillance for CKD and its risk factors	Provide population-specific information about the current status of detection and treatment of CKD	(4.1) Develop federal interagency agreement for sharing of data (4.2) Add CKD questions to BRFSS	National CKD surveillance project (CDC), USRDS (NIH)
5	Screen for CKD in high-risk population	Increased detection of CKD in high-risk populations	(5.1) Increase CKD testing (eGFR, microalbuminuria)	CHERISH (CDC), KEEP (NKF), NHANES (CDC)
6	Identify and close gaps in knowledge about CKD primary and secondary prevention	Establish an evidence base for CKD detection and control activities	(6.1) Conduct meta-analysis of current data to identify interventions that work (6.2) Promote targeted research funding by other organizations	
7	Develop prediction tools for progression to kidney failure	Enhance and detail more precisely the evidence base for risk stratification tools that can enhance treatment for CKD populations	(7.1) Conduct research on risk prediction for progression to kidney failure (7.2) Encourage other agency support	CKD cost-effectiveness project (CDC)
Target: providers, hospitals, clinical laboratories				
8	Strengthen provider education	Translation of evidence-based CKD care into medical education and community practice	(8.1) Develop and implement CME programs for detection, evaluation, and management (NKF-KDOQI clinical action plan) (8.2) Develop CKD resource to facilitate state program planning and monitoring progress toward national goals (8.3) Encourage and facilitate CKD education of PCPs and diabetes educators by nephrologists (8.4) Support NKDEP activities	KDOQI (NKF), RPA, NKDEP (NIH)
9	Improve laboratory procedures for CKD reporting	Increased accuracy of GFR estimation, albuminuria reporting, ease of CKD test interpretation	(9.1) Support recommendations for eGFR reporting	NKDEP (NIH)
Target: general public				
10	Increase public awareness of CKD	Support evidence-based consumer decision making about health, health risks, and health practices and behaviors related to CKD	(10.1) Promote NKDEP website (10.2) Disseminate activities for World Kidney Day, National Kidney Month (10.3) Assess Promotora model in CKD education	International Federation of Kidney Foundations, MMWR (CDC), NKDEP (NIH), NKF

Abbreviations: BRFSS, Behavioral Risk Factor Surveillance System; CDC, Centers for Disease Control and Prevention; CHERISH, CKD Health Evaluation and Risk Information Sharing; CKD, chronic kidney disease; CME, continuing medical education; CMS, Centers for Medicare & Medicaid Services; DQIP, Diabetes Quality Improvement Project; eGFR, estimated glomerular filtration rate; HEDIS, Healthcare Effectiveness Data and Information Set; KDOQI, Kidney Disease Outcomes Quality Initiative; KEEP, Kidney Early Evaluation Program; MMWR, Morbidity and Mortality Weekly Report; NCQA, National Committee for Quality Assurance; NHANES, National Health and Nutrition Examination Survey; NIH, National Institutes of Health; NKDEP, National Kidney Disease Education Program; NKF, National Kidney Foundation; PCP, primary care provider; QIO, Quality Improvement Organizations; RPA, Renal Physicians Association; USRDS, US Renal Data System.

## EXISTING PROGRAMS

Table 3 lists existing programs for surveillance, screening, and enhancing education and awareness.<sup>11,13,14,25,47-68</sup>

### Surveillance

Surveillance refers to an activity to provide key information about CKD, such as time, location, magnitude, and severity, to guide implementation of medical and public health measures to control the progression of CKD and its complications. Federally funded population-based registries and surveys that can be used for surveillance for various stages of CKD include the US Renal Data System (USRDS),<sup>11,48</sup> National Health and Nutrition Examination Survey (NHANES),<sup>13,14,50,51</sup> Centers for Medicare & Medicaid Services (CMS) End-Stage Renal Disease (ESRD) Network System,<sup>52-58</sup> and Quality Improvement Organizations (QIOs; Table 3).<sup>64</sup>

### Screening

Screening is an activity whereby persons in a defined population who are not aware of CKD are tested to detect the disease and subsequently treated to reduce the risk of progression of CKD and its complications. There is no current federal program for CKD screening. The National Kidney Foundation (NKF) Kidney Early Evaluation Program (KEEP) is an example of an ongoing screening program targeting populations at increased risk.<sup>65</sup>

### Enhancing Education and Awareness

These programs are essential to educate providers, patients and their families, and the public about CKD and its consequences. The National Kidney Disease Education Program (NKDEP) was established in 2000 with the goal of decreasing the burden of CKD in the United States.<sup>66</sup>

## RECOMMENDATIONS

The existing programs described provide a rich epidemiological database to indicate the populations at increased risk of the development, progression, and complications of CKD. Table 4 lists the panel's recommendations to the CDC to improve translation of prevention into practice.

Recommendations are grouped according to the target population. For each recommendation, a specific action is proposed, with examples of existing programs and systems within organizations with responsibility for public health activities regarding CKD or other related chronic diseases. Integration of activities of multiple organizations will be necessary to carry out these recommendations.

### People With CKD or at Increased Risk of Developing CKD

Recommendations 1 to 7 can be carried out by governmental agencies and nongovernmental organizations with a public health mission. Improving the detection of CKD in populations at increased risk (recommendation 5) is paramount. Table 5 provides more detail about recommended CKD testing for populations at increased risk.<sup>2,6,26-29</sup> Additional research about prediction of risk and strategies to improve outcomes is a key part of these recommendations.

### Providers, Hospitals, and Clinical Laboratories

Recommendations 8 and 9 are to strengthen provider education and improve laboratory procedures for CKD reporting. These measures will be necessary to improve the detection, evaluation, and management of CKD.

### General Public

Recommendation 10 is to increase public awareness of CKD. Improved health-related decision making will be essential for primary, secondary, and tertiary prevention.

These recommendations are applicable to patients with a number of chronic diseases, not just CKD. This is consistent with the recognition of CKD as a key component of a cluster of chronic diseases, including hypertension, diabetes, and CVD, affecting primarily the elderly and leading to substantially increased risk of mortality, morbidity, and cost. CKD commonly coexists with these other conditions; thus, it will be most efficient for a public health strategy for CKD to emphasize opportunities for CKD detection in

**Table 5. Current Recommendations for Screening for CKD**

Populations at Risk	Definition	Test and Criteria	When to Begin	How Often to Repeat	Group	Reference
Diabetes mellitus	Type 1	Urine ACR > 30 mg/g, eGFR < 60 mL/min/1.73 m <sup>2</sup>	5 y after diagnosis	Urine ACR: if positive, 2 more tests within 3-6 mo; if negative, annually eGFR: at least annually	ADA NKF	2, 29 26
Diabetes mellitus	Type 2	Urine ACR > 30 mg/g, eGFR < 60 mL/min/1.73 m <sup>2</sup>	At diagnosis	Urine ACR: if positive, 2 more tests within 3-6 mo; if negative, annually eGFR: at least annually	ADA NKF	2, 29 26
Hypertension	Blood pressure > 140/90 mm Hg, >130/80 mm Hg if diabetic and/or CKD	ACR > 30 mg/g, eGFR < 60 mL/min/1.73 m <sup>2</sup>	At first presentation	No data available	JNC7 NKF	6 27
CVD	Patients with CAD, MI, angina, CHF, stroke, PVD	Urine ACR > 30 mg/g, eGFR < 60 mL/min/1.73 m <sup>2</sup>	At presentation	If positive, repeat in 3 mo; if negative, annually	AHA NKF	28 28
Family history	History of CKD in first-degree relatives	Appropriate test for specific conditions, urine ACR > 30 mg/g, eGFR < 60 mL/min/1.73 m <sup>2</sup>	When identified	No data available	NKF	2

*Note:* Conversion factors for units: urine ACR in mg/g to mg/mmol, ×0.113; GFR in mL/min/1.73 m<sup>2</sup> to mL/s/1.73 m<sup>2</sup>, ×0.01667.

Abbreviations: ACR, albumin-creatinine ratio; ADA, American Diabetes Association; AHA, American Heart Association; CAD, coronary artery disease; CHF, congestive heart failure; CKD, chronic kidney disease; CVD, cardiovascular disease; eGFR, estimated glomerular filtration rate; JNC7, Joint National Commission for Prevention, Detection, Evaluation and Treatment of High Blood Pressure, 7<sup>th</sup> Report; MI, myocardial infarction; NKF, National Kidney Foundation; PVD, peripheral vascular disease.

coordination with existing public health strategies for these other diseases.

**CURRENT STATUS AND ACTIVITIES**

**Current CDC Projects**

The CDC is developing capacity and infrastructure for a public health approach to CKD in collaboration with partners from other government agencies, universities, and national organizations. The CDC CKD initiative includes projects in the areas of kidney disease surveillance and epidemiology, screening, health outcomes research, and health economics.<sup>10,98</sup> These efforts should result in improved assessment of the burden of CKD in the United States, a screening

program for CKD in states, documentation of direct and indirect costs of CKD, and development of a model that will not only help predict the development, progression, and complications of CKD, but also test the effectiveness of various public health interventions. The CDC has also developed a kidney disease interest group with other divisions and centers at the CDC and participates with other federal agencies, including the National Institutes of Health (National Institute of Diabetes and Digestive and Kidney Diseases [NIDDK] and NKDEP), CMS, and US Department of Veterans Affairs. The CDC kidney interest group and partners from states, universities, and other organizations published kidney-related reports in CDC’s weekly journal to

highlight National Kidney Month and World Kidney Day.<sup>99</sup>

### Global Initiatives

There is growing international interest in developing public health policies for CKD. World Kidney Day, an initiative of the International Federation of Kidney Foundations and the International Society of Nephrology, has been observed annually since March 2006 and seeks to send a message to the public, government health officials, health professionals, patients, and families that “CKD is common, harmful, and treatable.”<sup>86,87</sup> KDIGO (Kidney Diseases: Improving Global Outcomes) is an independent nonprofit foundation governed by an international board to promote the coordination, collaboration, and integration of initiatives to develop and implement clinical practice guidelines.<sup>4</sup> A KDIGO position paper issued in 2006 noted that few countries have policies for CKD and most are unaware of the high prevalence of CKD, its contribution to other diseases, or its economic burden.<sup>100</sup> KDIGO recommends that all governments adopt a public health policy for CKD, which should include support for screening and surveillance and public education programs.

The plan outlined for the United States may also be relevant to other developed countries with well-established infrastructure for public health. Developing countries face substantial obstacles to the initiation of public health programs for patients with all chronic diseases. CKD should be considered when implementing programs for other chronic diseases.

### SUMMARY

At the request of the CDC, the expert panel reviewed the current state, evidence, and issues related to CKD and recommended a comprehensive public health strategy to prevent the development, progression, and complications of CKD in the United States. The strategy focuses on primary, secondary, and tertiary prevention initiatives; targets people with CKD and at increased risk of developing CKD, providers, and the general public; and encourages integration of activities of multiple organizations with responsibility for public health activities for patients with chronic diseases. This strategy can be translated

locally and globally to improve outcomes for CKD.

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