
# THE IMPACT OF CHRONIC KIDNEY DISEASE IN WEST VIRGINIA

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# Executive Summary

## General Facts

- The kidneys are the chemists of our bodies. They have three main functions: (1) remove waste products, (2) balance our bodies' chemicals, and (3) produce essential hormones.

- The kidneys filter approximately 50 gallons of blood every day; in general, a healthy adult will eliminate approximately one to two quarts of urine daily. If the kidneys do not function properly, wastes accumulate in the body. The progressive loss of kidney function eventually leads to end-stage renal disease (ESRD), or kidney failure, resulting in the need for either dialysis or kidney transplantation.

- The National Kidney Foundation (NKF) estimates that 1 in every 9 adults in the United States, more than 20 million people, has chronic kidney disease (CKD) and that more than 20 million others are at increased risk for the disease.

- CKD disproportionately affects older adults, those with a family history of the disease, and African Americans, Hispanics, Asian/Pacific Islanders, and Native Americans. Other risk factors include diabetes, hypertension, urinary tract infections, urinary stones, obesity, autoimmune diseases, and systemic infections.

- Diabetes is the leading cause of kidney failure, followed by hypertension. The third most common cause is glomerulonephritis, a group of diseases that cause damage to the kidney's filtering units (glomeruli). Inherited kidney diseases such as polycystic kidney disease constitute the fourth most common cause.

- CKD often coexists with cardiovascular disease (CVD). In fact, people in the early stages of CKD have been recognized by the American Heart Association as being among the "highest-risk" group for CVD. CVD risk factors are considered risk factors for CKD as well, including diabetes, hypertension, obesity, cigarette smoking, high cholesterol, and physical inactivity.

- Treatment for CKD includes blood sugar and blood pressure control, weight control, protein- and salt-restricted diets, treatment for anemia, which occurs almost universally among dialysis patients, and referral to a nephrologist before complications and comorbidities become severe.

## West Virginia Statistics

- West Virginia consistently reports high rates of CKD/CVD risk factors. According to the most recent data from the Behavioral Risk Factor Surveillance System, the state has the highest rates of diabetes and hypertension diagnoses in the nation. In addition, West Virginia has the 2$^{nd}$ highest rates of current smoking and high cholesterol, the 3$^{rd}$ highest rate of obesity, and the 11$^{th}$ highest rate of physical inactivity.

- According to data from the United States Renal Data System, West Virginia's rate of ESRD incidence (new cases per year) was consistently higher than the national rate from 1994-2003. Both ESRD incidence and prevalence (all living ESRD patients) among patients with diabetes have risen at a faster rate in the state than in the nation over the 10-year period.

- From 1995 through 2004, the number of hospital discharges in West Virginia with a principal diagnosis of kidney disease increased 160%, from 1,183 to 3,076. The billed charges for these hospitalizations increased 253% over the period, from $13,667,000 to $48,178,000. In 2004, 73% of charges for hospitalizations with a principal diagnosis of kidney disease were billed to Medicare.

- The number of dialysis patients in West Virginia increased 75% from 1993 to 2004, from 929 to 1,625. In 2004, nearly one-half (49%) of dialysis patients had a primary diagnosis of diabetes; 24% had a primary diagnosis of hypertension.

- In 2004, there were 568 deaths in the state due to kidney disease, 244 men and 324 women. The majority of these deaths were attributed to renal failure (443, or 78%), with 112 (20%) a result of hypertension with renal disease. Most of the deaths (467, or 82%) occurred among West Virginians aged 65 and older.

- In 2006, there were 40 nephrologists practicing in West Virginia. There were 24 dialysis providers and 2 transplant centers.

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# I. The Basics of Chronic Kidney Disease

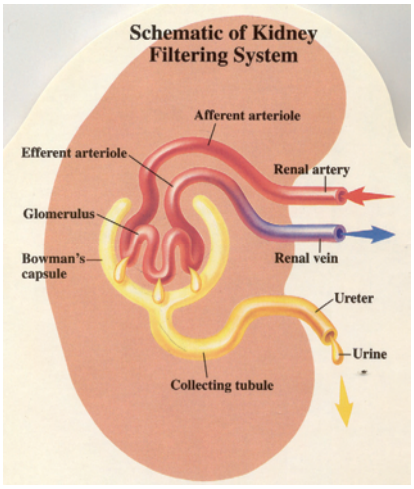
Chronic kidney disease (CKD) has been designated as a worldwide public health problem by the National Kidney Foundation (NKF). The prevalence of CKD is rising, along with the prevalence of kidney failure, widely known as end stage renal disease (ESRD). The NKF estimates that if the incidence of CKD continues to increase at its current rate of 8% per year more than 600,000 people in the United States will require kidney replacement therapy in the form of dialysis or transplantation by 2010 (1). If kidney disease is diagnosed in its early stages, the progression from CKD to ESRD can be significantly slowed and the costs and suffering that accompany the adverse outcomes of CKD can be reduced. This report presents an overview of CKD and the growing impact the disease is having on the State of West Virginia.

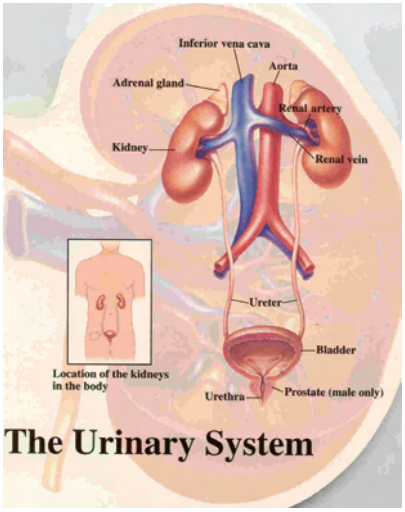
The kidneys are the chemists of our bodies. They have three main functions:

1. Remove waste products
2. Balance our bodies' chemicals
3. Produce essential hormones

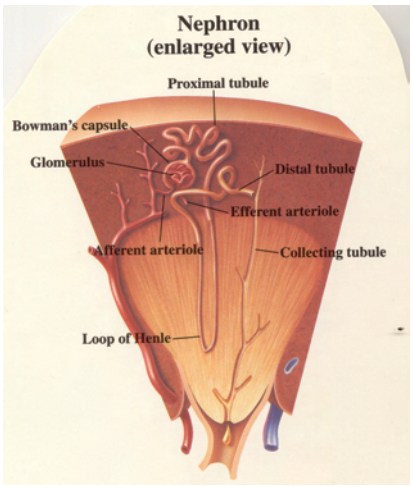
**The chemists.** The kidneys, the chemists of our bodies, perform three vital, highly complex functions. They (1) remove waste products and excess fluids from our blood, excreted in the form of urine; (2) maintain the stable balance of body chemicals by regulating the body's salt, potassium, and acid content; and (3) produce hormones essential to the production of red blood cells, the regulation of blood pressure, the conversion of vitamin D into an active form the body can use, and the control of bone metabolism. Although humans normally have two kidneys, one kidney can adequately perform these functions.

The kidneys are located on either side of the spine at the lowest level of the rib cage. Blood flows into the kidney through the renal artery, which then branches into increasingly smaller arteries, each of which ends in a filtration unit called a nephron. Each of the kidney's millions of nephrons consists of a network of tiny blood vessels called a glomerulus, which is attached to a tubule. Water, electrolytes (sodium, potassium, calcium, magnesium, and others), and small molecules are filtered into the tubule. Larger substances such as proteins, lipids, and blood cells are not filtered across the glomerulus. In the tubule, water and needed electrolytes are reabsorbed and retained. Blood leaving the nephron returns to the general circulation via the renal veins. All chemicals that are filtered but not reabsorbed are excreted into the urine. The volume of urine and amount of electrolytes lost each day are determined by the body's needs and vary based upon fluid and food intake, as well as medical conditions such as congestive heart failure or kidney insufficiency. Approximately 50 gallons of blood are filtered every day. In general, a healthy adult will eliminate approximately one to two quarts of urine daily.



If the kidneys do not function properly, the wastes normally excreted in the urine accumulate in the body. Progressive loss of kidney function leads to ESRD, resulting in the need for either dialysis or transplantation.




**The public health problem of CKD.** The NKF estimates that 1 in every 9 adults in the United States, more than 20 million people, has CKD, and that more than 20 million others are at increased risk for the disease (2). Alarmingly, the majority of this at-risk population is not even aware of the problem. Treatment at earlier stages of CKD can slow down or prevent progression of the disease itself and the cardiovascular complications that often accompany CKD. However, CKD is both underdiagnosed and undertreated in West Virginia, as well as in the United States, resulting in a growing need for kidney replacement therapy (i.e., dialysis or transplantation). This is in part due to a lack of consistency in recognizing individuals in early stages of CKD when intervention could affect outcomes. In 1999 the NKF developed the Kidney Disease Outcomes Quality Initiative (K/DOQI), which resulted in the development of guidelines for the evaluation, classification, and stratification of CKD[1]. Major efforts are under way to educate health care professionals and the public about the importance of evaluating at-risk individuals for the presence of kidney disease, recognizing persons who have undetected CKD, and using therapies that are effective in preventing the continued loss of kidney function.

> CKD is a major public health problem that is both underdiagnosed and undertreated in West Virginia and the United States. If CKD continues to increase at its current rate, over 600,000 people will suffer kidney failure by 2010.
>
> National Kidney Foundation

## Definition of Chronic Kidney Disease

The NKF guidelines define chronic kidney disease by (a) the presence or absence of kidney damage and (b) the level of kidney function as measured by the glomerular filtration rate (GFR):

1. Kidney damage for at least three months, defined by structural or functional abnormalities of the kidney, with or without decreased GFR, manifest by either (a) pathological abnormalities of the kidney or (b) markers[2] of kidney damage, i.e., abnormalities in the composition of the blood or urine, or abnormalities in imaging tests[3]; or

2. GFR <60mL/min/1.73m$^2$ for at least three months, with or without kidney damage.

[1] K/DOQI Clinical Practice Guidelines for Chronic Kidney Disease: Evaluation, Classification, and Stratification. Part 4, Guideline 2.
[2] Common markers of kidney damage include albuminuria (excess albumin, a specific protein, in the urine) and proteinuria (excess of total protein in the urine).
[3] Imaging tests include CT and MRI scans and ultrasound.

**GFR filtration.** GFR is estimated from the blood's level of creatinine, a waste product that comes from muscle tissue. The creatinine level in the blood increases if kidney function is abnormal, due to decreased filtration of creatinine into the urine. Blood creatinine levels vary according to size, diet, and muscle mass, and level of kidney function, however, and therefore are an unreliable measure of kidney function when used alone. Recently, equations that provide estimations of GFR have been introduced that are reliable and more practical than the original equation, which required values for several variables including the patient's age, sex, blood urea nitrogen (BUN), serum creatinine, and albumin. The simpler version requires only values for serum creatinine, age, sex, and race (African American or not). (For both equations, the calculated GFR is multiplied by 1.20 for African Americans.) Separate equations are available to estimate GFR in children. The most commonly used equations for estimating creatinine clearance and GFR are listed in Appendix B.

It is becoming increasingly important to identify individuals who have decreased kidney function, particularly the elderly and those with diabetes or other risk factors for cardiovascular disease. Use of these equations will greatly improve recognition of patients with impaired kidney function and will assist in the management of patients who are at risk for developing acute kidney failure or who require adjustments in medication dosage.

Eventually, clinical laboratories will be required to routinely report estimated GFR whenever serum creatinine is ordered, likely when standards for creatinine calibration and measurement are universally adopted. Refinements in the equations used to estimate GFR will also likely occur that will improve their accuracy. In the meantime, laboratory methodology exists in the state to use the currently recommended equations. Use of the original equation that required additional information about the patient or a timed urine collection is no longer necessary to provide an adequate evaluation. At present, approximately 20% of hospital laboratories in West Virginia provide estimated GFR values when a serum creatinine is performed. Many other facilities in the state will be doing so in the near future.

**Stages of CKD.** The NKF further recommends that individuals with CKD be classified according to their level of estimated GFR, a stratification allowing clinicians to focus their efforts on specific interventions. CKD is divided into five stages based on GFR level; these represent how efficiently the kidneys are working to remove wastes from the blood:

**Table 1. Stages of Chronic Kidney Disease**

| Stage | Description | GFR ($mL/min/1.73m^2$) |
|---|---|---|
| 1 | Kidney damage with normal GFR | 90 or over |
| 2 | Mild kidney damage | 60-89 |
| 3 | Moderate kidney damage | 30-59 |
| 4 | Severe kidney damage | 15-29 |
| 5 | Kidney failure (ESRD) | <15 |

Source: NKF K/DQOI

As of October 2005, Medicare began using new coding from the International Classification of Diseases, Revision 9 (ICD-9) for patients with CKD, as shown in Table 2.

These codes are designated by CKD stage, which is determined by GFR level, and should be reported for each encounter between a patient and health care practitioner.

| Table 2. ICD-9 Codes for Chronic Kidney Disease | | |
|---|---|---|
| GFR (mL/min/1.73m$^2$) | CKD Stage | ICD-9 Code |
| 90 or over | 1 | 585.1 |
| 60-89 | 2 | 585.2 |
| 30-59 | 3 | 585.3 |
| 15-29 | 4 | 585.4 |
| <15 | 5 | 585.5 |
| Dialysis | ESRD | 585.6 |
| CKD unspecified | Chronic renal insufficiency<br>Chronic renal disease<br>Chronic renal failure, NOS | 585.8 |

## Risk Factors for Chronic Kidney Disease

CKD is often referred to as a "silent" disease because symptoms in the early stages are absent. As the disease advances to a later stage, vague, nonspecific symptoms may go unreported until a patient's quality of life becomes compromised. If patients at risk for CKD are identified early on, progression of the disease can possibly be slowed and the risk of mortality reduced.

The NKF divides risk factors into three categories: (1) **susceptibility** factors, (2) **initiation** factors, and (3) **progression** factors. Susceptibility factors are nonmodifiable factors that increase an individual's susceptibility to kidney damage, such as older age, family history of diabetes or hypertension, and race. CKD disproportionately affects African Americans, Hispanics, Asian/Pacific Islanders, Native Americans, and the elderly (3). African Americans are nearly 4 times as likely to suffer kidney failure as whites, while Native Americans are twice as likely and Asian/Pacific Islanders are 1.3 times as likely. Hispanics are about 1.5 times more likely to have kidney failure than non-Hispanics. Initiation factors are modifiable (controllable and/or treatable) factors that are directly linked with the onset of kidney damage, e.g., diabetes and high blood pressure. Intervention at first identification of these factors can mitigate damage. Progression factors are those that can worsen damage and hasten decline in kidney function once initial damage has been assessed; these include smoking and poor blood pressure and glycemic control. CKD risk factors are shown below in Table 3.

| Table 3. Risk Factors for Chronic Kidney Disease | |
|---|---|
| **Type of Risk Factor** | **Examples** |
| Susceptibility | Older age, family history, race |
| Initiation | Diabetes, high blood pressure, autoimmune diseases, systemic infections, urinary tract infection or obstruction, drug toxicity, urinary stones, obesity |
| Progression | High level of proteinuria, smoking, poor blood pressure or glycemic control |
| Source: NKF K/DQOI | |

## Causes of Chronic Kidney Disease

The two primary causes of CKD are diabetes and hypertension. Other causes include glomerulonephritis, polycystic kidney disease, congenital malformations, autoimmune diseases such as lupus vasculitis, and recurrent urinary infections or stones. Chronic exposure to nephrotoxic drugs such as non-steroidal anti-inflammatory agents or environmental factors such as lead and other heavy metals can also lead to the development of CKD.

**Diabetes.** Diabetic nephropathy is the leading cause of kidney failure and accounts for approximately 45% of all dialysis patients in the United States (4). Poorly controlled diabetes, either type 1 or type 2, can result in damage to the small blood vessels, decreasing the ability of the kidneys to remove waste products from the blood. Diabetes can also injure nerves, which in turn can cause problems with emptying the bladder. Infections can result from urine being retained in the bladder for prolonged periods of time; in addition, the pressure from a full bladder can cause kidney damage.

Diabetic nephropathy is characterized by (1) proteinuria, or excess protein, initially albumin[4], in the urine, and (2) progressive kidney failure. In its earliest stages, diabetic involvement of the kidneys is characterized by the presence of "microscopic" amounts of albumin in the urine (microalbuminuria), measured by an albumin-to-creatinine ratio (ACR) in the urine. As injury to the kidneys progresses, other proteins in addition to albumin are inappropriately lost through the glomerulus, leading to proteinuria. Diabetic nephropathy progresses gradually over the years, from microalbuminuria (an ACR of between 30 and 300), to macroalbuminuria (an ACR of greater than 300), and eventually to proteinuria (protein excretion exceeding several grams per day), or overt nephropathy.

Microalbuminuria typically presents between 5 and 15 years after diagnosis in type 1 diabetes; macroalbuminuria usually follows in 10 to 15 years, with kidney failure developing in about 50% of patients (5). In type 2 diabetes, there is a more variable course, with microalbuminuria often present at diagnosis, often because the diabetes has gone undetected for many years. **About 30% of those patients with microalbuminuria will progress to macroalbuminuria if there is no intervening treatment; approximately 20% of patients not receiving treatment will progress to kidney failure within 20 years (5).**

Signs and symptoms of early kidney disease in diabetic patients are nonexistent or minimal. Symptoms of advanced disease may include nausea, vomiting, anemia, itching, ankle and leg swelling, more frequent urination, and frequent hypoglycemia with less need for insulin (diseased kidneys cause less breakdown of the insulin in the body). There are increased levels of BUN, as well as increased creatinine levels. In addition, proteinuria is present and blood pressure becomes more difficult to control.

**Hypertension.** High blood pressure, the second most common cause of CKD, is both a cause and consequence of kidney disease. In one-third of patients starting dialysis, kidney failure has been caused by long-standing hypertension. In addition, approximately 80% of CKD patients have hypertension, regardless of the cause, for several reasons (6). Failing kidneys can trigger increased activity of the sympathetic nervous system, resulting in raised blood pressure. Also, certain substances (angiotensin) released in response to blood pressure changes within the kidney

[4] Albumin, produced by the liver, normally constitutes about 55% of blood plasma proteins and plays a significant role in the distribution of body fluids between body tissues and within blood vessels. A healthy kidney prevents the filtration of albumin into the urine.

can cause retention of salt and water, blood vessel constriction, and an increase in blood pressure. Renal artery stenosis (RAS) due to atherosclerosis or abnormal arterial wall thickening can cause restricted blood flow to the kidneys, resulting ultimately in loss of kidney function.

**Glomerulonephritis.** The third most common cause of CKD is glomerulonephritis (GN), a group of diseases that cause damage to the kidney's filtering units (glomeruli). GN can occur suddenly or develop gradually over several years. It may be reversible, with complete recovery of kidney function, or it may progress, eventually causing the glomeruli to be permanently destroyed, leading to loss of kidney function and eventual kidney failure. GN can be primary, affecting the kidney alone, or secondary, occurring as a result of, or a manifestation of, another disease.

There are many different causes of GN, and often the exact cause of the disease is unknown. Many kinds of GN can result from an immune system problem, where the body's own immune system mistakenly attacks and injures the glomeruli. A number of antibodies have been implicated as both primary and secondary causes of GN. Signs and symptoms range from asymptomatic hematuria (blood in the urine) to the acute nephritic syndrome (abnormal urine test, kidney failure, and proteinuria). Chronic GN may be clinically silent with no signs other than proteinuria, with or without a decline in kidney function. Acute GN may also present without overt symptoms; however, abnormal urine and blood tests should signal the need for rapid intervention before irreversible kidney damage occurs. Therefore, all individuals with proteinuria or microscopic hematuria should be evaluated for the possibility of GN.

**Inherited kidney disease.** The fourth most common cause of CKD is a group of inherited kidney diseases, the most common of which is polycystic kidney disease (PKD), estimated to affect 1 in every 500 to 1,000 people (7). Adult-type PKD is an autosomal dominant genetic trait, so as many as 50% of children with an affected parent may have the disease. Approximately 5% of dialysis and transplant patients in the U.S. have PKD (7).

In PKD, large, fluid-filled cysts form inside the kidneys, causing the kidneys to enlarge and become distorted. Cysts may spontaneously rupture, causing pain, fever, and blood in the urine. While the progression of the disease varies among individuals, most eventually require dialysis or transplantation early in life. Most cases of PKD are diagnosed by age 20 or 30 by ultrasound evidence of multiple cysts, which are also commonly found in the liver and ovaries. A decline in kidney function occurs gradually over decades. Three-fourths (75%) of people with PKD have high blood pressure and 20% may have cerebral aneurysms. Significant advances in recent years can dramatically retard the loss of kidney function in patients with PKD.

A less common form of hereditary cystic kidney disease is infantile-type PKD. This condition typically affects children in their early years, resulting in advanced kidney failure within a few years. This is an autosomal recessive trait, with a 25% chance of inheritance from an affected parent.

Alport's Syndrome is another uncommon inherited disease that affects the kidneys. The disorder primarily affects males since the genetic defect is usually found on the X chromosome. Because early damage to the kidneys can result in blood in the urine, it is sometimes diagnosed at a young age. Alport's Syndrome affects the membranes of the kidney (glomeruli), eyes, and ears. It typically progresses to loss of kidney function, deafness, and vision difficulties.

**Other causes of CKD**. Other causes of CKD include congenital malformations of the kidneys, problems caused by obstructions in the kidney such as kidney stones or tumors, repeated

urinary tract infections, narrowing of the arteries that supply blood to the kidneys, and simple degenerative changes. Patients with chronic cystic disease should be periodically evaluated for the presence of kidney cancer.

## Cardiovascular Disease and Its Complications in CKD

CKD often coexists with cardiovascular disease (CVD). People in the early stages of CKD have been recognized by the American Heart Association as being among the "highest-risk" group for CVD (8). CVD risk is increased 1.5 to 3.5 times with CKD (9) and is the most common cause of death among patients with ESRD (10). Recent statistics suggest that patients with advanced CKD are more likely to die before progressing to ESRD and the need for dialysis (11).

> "What we have recognized in recent years is that patients with any form of chronic kidney disease are also at high risk of cardiovascular events."
>
> Dr. Mark J. Sarnak
> American Heart Assoc.

Patients with CKD have decreased survival rates after myocardial infarction, with the incidence of post-infarct complications increasing with decreased kidney function (12). The risk for CVD in general increases dramatically as the level of kidney function decreases. Individuals with severe kidney insufficiency experience a threefold higher rate of CVD and hospitalization than those with mild disease (13).

While even individuals with a small loss of kidney function have twice the risk of developing CVD than those with fully functioning kidneys, patients being treated by dialysis for late stage disease were found in one study to be 10 to 30 times more likely than the general population to die from a CVD event, even after controlling for sex, race, and diabetes status. After controlling for age, there remained a fivefold risk of CVD mortality in dialysis patients (8). Transplant recipients have a lower risk of CVD mortality than dialysis patients but are still twice as likely to die from CVD as the general population, and CVD morbidity among transplant recipients is 3 to 5 times that found in the general population (8). The prevalences of atherosclerosis, heart failure, and left ventricular hypertrophy[5] (LVH) are all significantly higher among dialysis patients (8), and a majority of CKD patients are affected long before they reach ESRD. High systolic blood pressure and anemia have been identified as two modifiable predictors of LVH. Intervention in the earlier stages of CKD to treat these risk factors and others (high blood cholesterol, poor glucose control, and increased hypertension) could positively impact outcomes for CKD patients.

Because of the linkage between kidney and heart disease, screening CKD patients for the presence of CVD and vice versa is of paramount importance. Identification of traditional risk factors associated with CVD, i.e., older age, diabetes, hypertension, high cholesterol levels, smoking, LVH, and obesity, is vital in all patients. In addition, those independent CVD risk factors unique to people with CKD, such as anemia, malnutrition, elevated inflammation markers, and calcium and phosphorus metabolism abnormalities, should be identified and aggressively treated.

[5] Left ventricular hypertrophy is the enlargement of the left ventricle of the heart, caused by sustained high blood pressure or volume, which is an independent risk factor for CVD mortality.

## Prevalence of Selected CKD/CVD Risk Factors in West Virginia

**Older Age.** A major risk factor for both CKD and CVD is older age. In 2000, West Virginia had the oldest median age in the nation at 38.9, markedly higher than the national average of 35.3. In addition, West Virginia was third in the nation in the percentage of its population aged 65 and older (15.3%). Only Florida (17.6%) and Pennsylvania (15.6%) had higher percentages of elderly residents.

**Diabetes.** As noted earlier, diabetes is the leading cause of kidney failure. In 2004, West Virginia had the *highest* rate of diagnosed diabetes in the United States, with more than 1 in every 10 adults in the state reporting diabetes, according to the Behavioral Risk Factor Surveillance System (BRFSS)[6]. The state rate of 10.9% was significantly higher than the national rate of 7.0%. As shown in Table 4, both men and women in the state were significantly more likely to report having been diagnosed with diabetes than were their national counterparts, as were state respondents in every age group except those under the age of 35. Figure 1 on the following page illustrates the trend in diabetes awareness over the past decade; an increase has been recorded in West Virginia in every year except 2003.

**Table 4. Prevalence (%) of diabetes awareness* by gender and age**
**West Virginia and United States, Behavioral Risk Factor Surveillance System, 2004**

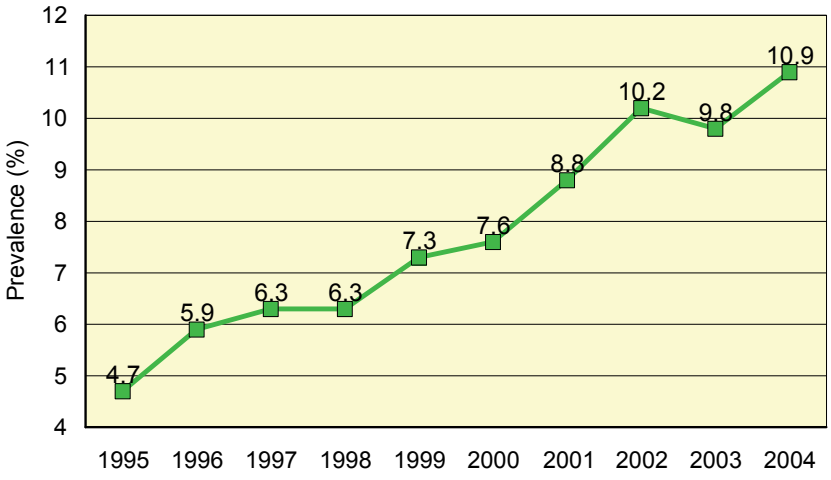
| Characteristic | West Virginia (95% CI) | United States (median) |
|---|---|---|
| Total | 10.9 (9.7-12.0) | 7.0 |
| Gender | | |
| Male | 11.6 (9.7-13.5) | 7.1 |
| Female | 10.2 (8.9-11.6) | 6.3 |
| Age | | |
| 18-24 | 1.4 (0.0-3.1) | 0.7 |
| 25-34 | 1.9 (0.3-3.4) | 1.4 |
| 35-44 | 6.6 (4.0-9.1) | 3.7 |
| 45-54 | 10.5 (7.9-13.0) | 7.1 |
| 55-64 | 19.3 (15.9-22.8) | 12.5 |
| 65+ | 22.1 (18.9-25.3) | 16.1 |

*Answered "yes" when asked "Have you ever been told by a doctor that you have diabetes?"

**Hypertension.** High blood pressure is the second leading cause of kidney failure. In 2003 (the most recent data available), West Virginia had the *highest* prevalence of hypertension among all BRFSS participating states and territories. More than one-third (33.6%) of the state's adults reported having been told they had high blood pressure, a significantly higher percentage than in the nation as a whole (25.8%). Both men and women in the state were significantly more likely to have high blood pressure than men and women nationwide, as were state respondents in all age groups except the youngest (18-24), as shown in Table 5. Figure 2 illustrates the upward trend in hypertension among West Virginia's adults since 1994.

[6] The BRFSS is a monthly telephone survey established by the Centers for Disease Control and Prevention to monitor health behaviors among adults aged 18 and older and conducted in all 50 states and the District of Columbia, as well as certain territories. BRFSS data were obtained from www.cdc.gov/brfss/index.htm.

Figure 1. Prevalence of diabetes awareness by year
West Virginia BRFSS, 1995-2004



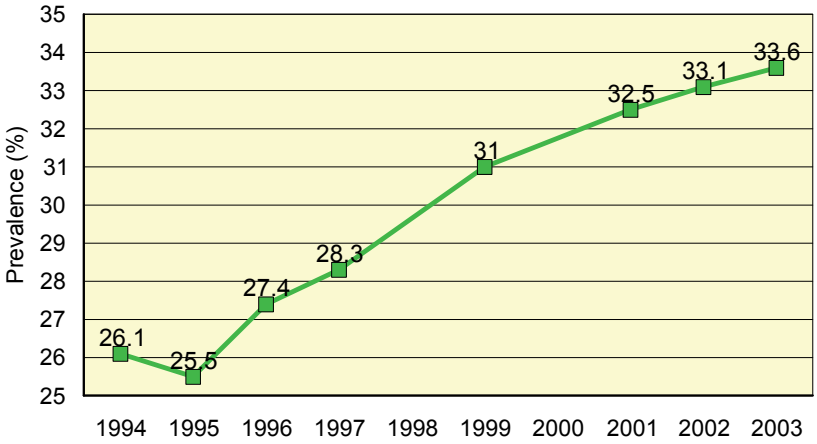

Source: Behavioral Risk Factor Surveillance System

**Table 5. Prevalence (%) of hypertension awareness* by gender and age**
**West Virginia and United States, Behavioral Risk Factor Surveillance System, 2003**

| Characteristic | West Virginia (95% CI) | United States (median) |
|---|---|---|
| Total | 33.6 (31.8-35.3) | 24.8 |
| Gender | | |
| Male | 35.0 (32.2-37.7) | 25.0 |
| Female | 32.3 (30.0-34.5) | 24.9 |
| Age | | |
| 18-24 | 7.5 (3.8-11.1) | 5.1 |
| 25-34 | 13.1 (9.6-16.5) | 8.2 |
| 35-44 | 25.4 (21.3-29.5) | 15.3 |
| 45-54 | 33.7 (29.8-37.6) | 26.7 |
| 55-64 | 50.7 (46.4-54.9) | 41.8 |
| 65+ | 59.9 (56.2-63.3) | 54.1 |

*Adults who have been told they have high blood pressure

Figure 2. Prevalence of hypertension awareness by year
West Virginia BRFSS, 1994-2003




Source: Behavioral Risk Factor Surveillance System
NOTE: Data not available for the years 1998 and 2000

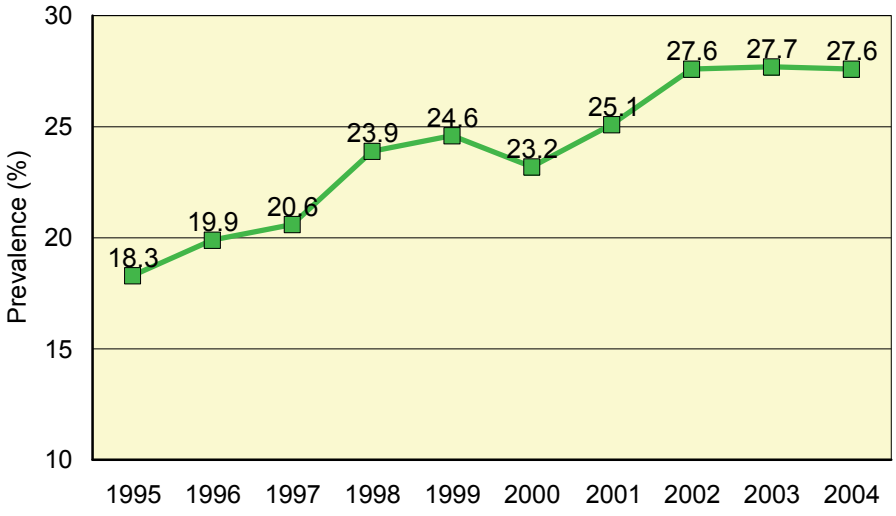
**Obesity.** Obesity is a documented risk factor for CKD and many of its common comorbidities, including diabetes, CVD, and hypertension. In 2004, West Virginia ranked *third* among BRFSS participants in the prevalence of obesity, defined as a body mass index (BMI) of 30 or greater. Twenty-eight percent (27.6%) of adult West Virginians were obese, compared with 23.1% of adults nationwide, a statistically significant difference (Table 6). Both men and women were significantly more likely to be obese in the state than in the nation, as were middle-aged adults (45-64). The upward trend in obesity in West Virginia has leveled out somewhat since 2002 (Figure 3).

**Table 6. Prevalence (%) of obesity* by gender and age**
**West Virginia and United States, Behavioral Risk Factor Surveillance System, 2004**

| Characteristic | West Virginia (95% CI) | United States (median) |
|---|---|---|
| Total | 27.6 (25.9-29.3) | 23.1 |
| Gender | | |
| Male | 28.5 (25.8-31.3) | 23.6 |
| Female | 26.7 (24.5-28.8) | 22.5 |
| Age | | |
| 18-24 | 16.9 (10.9-22.8) | 13.5 |
| 25-34 | 26.8 (22.2-31.4) | 22.5 |
| 35-44 | 28.9 (24.7-33.0) | 25.2 |
| 45-54 | 31.7 (27.9-35.5) | 26.9 |
| 55-64 | 37.2 (33.0-41.4) | 29.2 |
| 65+ | 22.5 (19.4-25.6) | 20.2 |

*BMI=30+

Figure 3. Prevalence of obesity by year
West Virginia BRFSS, 1995-2004




Source: Behavioral Risk Factor Surveillance System

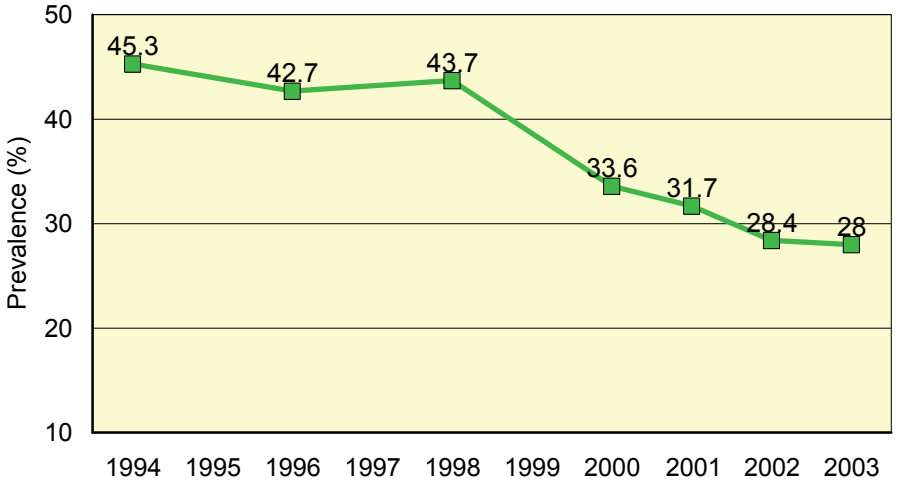
**Physical Inactivity.** Regular physical activity is important for several reasons, including weight control, blood pressure and glucose control, lowering cholesterol levels, and overall functioning. The NKF recommends physical conditioning for all CKD patients, even those in stage 5 disease who are on dialysis[7]. In 2003, 28% of adults in West Virginia reported to the BRFSS that they were physically inactive, i.e., had not participated in any physical activities during the month prior to their interview. This rate was significantly higher than the national median of 23%. Both men and women in the state were significantly more likely to be inactive than their national counterparts, as were middle-aged adults (aged 35-64), as shown below in Table 7. There has been moderate improvement in this risk factor, as illustrated in Figure 4.

**Table 7. Prevalence (%) of physical inactivity* by gender and age**
**West Virginia and United States, Behavioral Risk Factor Surveillance System, 2003**

| Characteristic | West Virginia (95% CI) | United States (median) |
|---|---|---|
| Total | 28.0 (26.2-29.7) | 23.1 |
| Gender | | |
| Male | 24.9 (22.3-27.4) | 20.8 |
| Female | 30.9 (28.6-33.1) | 24.8 |
| Age | | |
| 18-24 | 13.6 (8.2-18.9) | 16.1 |
| 25-34 | 22.8 (18.6-26.9) | 20.0 |
| 35-44 | 28.4 (24.2-32.5) | 21.4 |
| 45-54 | 30.9 (27.1-34.6) | 23.3 |
| 55-64 | 32.6 (28.6-36.5) | 26.9 |
| 65+ | 34.3 (30.7-37.8) | 32.4 |

*Did not participate in any physical activities prior to the interview

Figure 4. Prevalence of physical inactivity by year
West Virginia BRFSS, 1994-2003




Source: Behavioral Risk Factor Surveillance System
NOTE: Data not available for the years 1995, 1997, and 1999

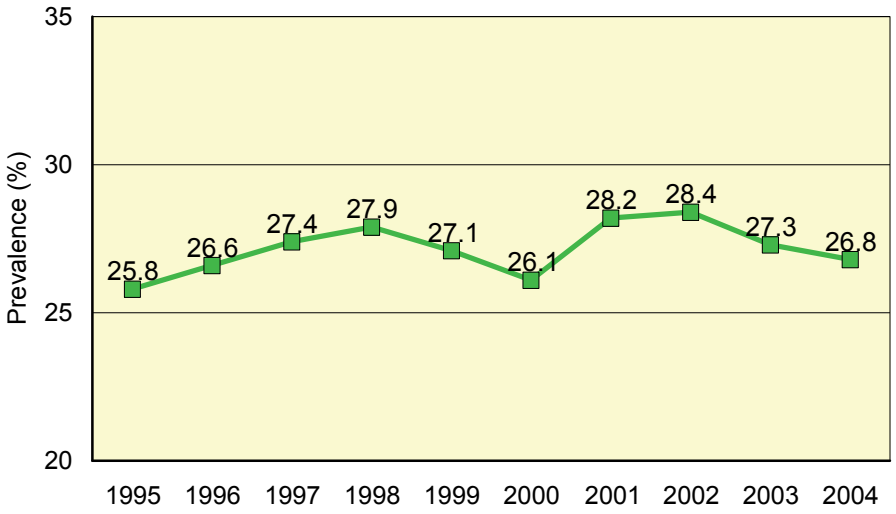
[7] K/DOQI Clinical Practice Guidelines for Cardiovascular Disease in Dialysis Patients. Section II, Guideline 14.

**Smoking.** Cigarette smoking is a well documented risk factor for CKD and CVD. West Virginians have traditionally had higher rates of smoking than those in most other parts of the country. In 2004, West Virginia ranked *second* among 52 BRFSS participants in prevalence of current cigarette smoking with a rate of 26.8%, significantly higher than the national median of 20.8% (Table 8). Men and women were both significantly more likely to smoke than those in the United States, as were adults aged 18-54. Figure 5 shows rates of smoking in the state from 1995 through 2004.

**Table 8. Prevalence (%) of current cigarette smoking by gender and age West Virginia and United States, Behavioral Risk Factor Surveillance System, 2004**

| Characteristic | West Virginia (95% CI) | United States (median) |
|---|---|---|
| Total | 26.8 (25.1-28.6) | 20.8 |
| Gender | | |
| Male | 27.4 (24.6-30.2) | 23.0 |
| Female | 26.3 (24.1-28.5) | 19.0 |
| Age | | |
| 18-24 | 37.5 (29.9-45.2) | 28.2 |
| 25-34 | 32.7 (28.0-37.4) | 26.2 |
| 35-44 | 35.7 (31.4-40.0) | 23.9 |
| 45-54 | 28.6 (24.9-32.3) | 22.2 |
| 55-64 | 21.0 (17.5-24.4) | 18.3 |
| 65+ | 10.0 (7.8-12.2) | 9.1 |

Figure 5. Prevalence of current cigarette smoking by year
West Virginia BRFSS, 1995-2004




Source: Behavioral Risk Factor Surveillance System

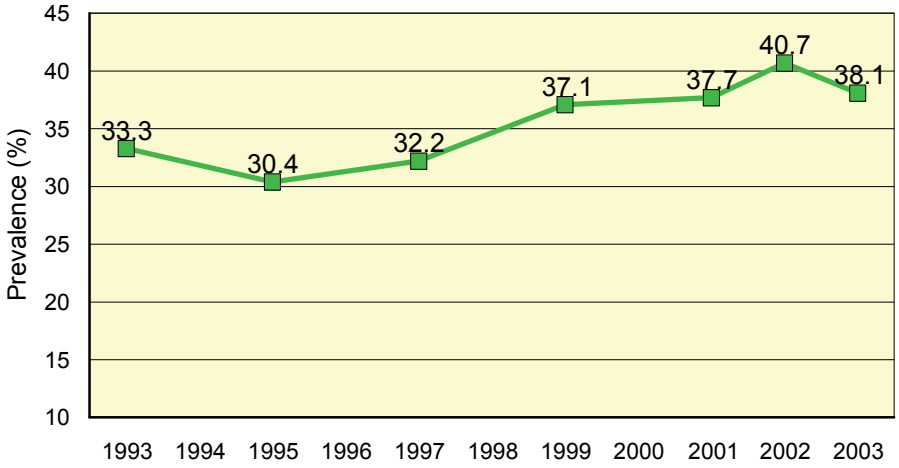
**High cholesterol.** The fact that CKD patients are in the highest risk group for CVD makes monitoring cholesterol and triglyceride levels and lowering these levels if necessary very important. West Virginia ranked *second* among all BRFSS participants in 2003 in cholesterol awareness prevalence (percentage of adults who have had their blood cholesterol checked and have been told it was high). The state's rate of 38.1% was significantly higher than the national median of 33.1% (Table 9). There was no difference among state men and those elsewhere in the country in cholesterol awareness; however, women in West Virginia were significantly more likely than other women and state men to have high cholesterol. Adults aged 25-34 and 55-64 were more likely than their national counterparts to have been told their cholesterol was high. There has been an upward trend in cholesterol awareness in West Virginia in the past decade (Figure 6).

**Table 9. Prevalence (%) of cholesterol awareness* by gender and age**
**West Virginia and United States, Behavioral Risk Factor Surveillance System, 2003**

| Characteristic | West Virginia (95% CI) | United States (median) |
|---|---|---|
| Total | 38.1 (36.0-40.1) | 33.1 |
| Gender | | |
| Male | 33.8 (30.7-36.8) | 33.8 |
| Female | 41.7 (39.0-44.3) | 32.0 |
| Age | | |
| 18-24 | 10.5 (2.8-18.1) | 8.1 |
| 25-34 | 21.2 (16.1-26.2) | 15.5 |
| 35-44 | 29.9 (25.1-34.6) | 25.4 |
| 45-54 | 37.4 (33.2-41.5) | 35.0 |
| 55-64 | 52.5 (48.0-56.9) | 46.4 |
| 65+ | 51.1 (47.1-55.0) | 47.9 |

*Adults who have had their blood cholesterol checked and have been told it was high

Figure 6. Prevalence of cholesterol awareness* by year
West Virginia BRFSS, 1993-2003




*Among those who have ever had their cholesterol checked
NOTE: Data not available for the years 1995, 1997, and 1999
Source: Behavioral Risk Factor Surveillance System

## Treatment of Chronic Kidney Disease

The NKF[8] recommends that patients at risk for CKD be evaluated according to the following six categories: (1) diagnosis (type of kidney disease); (2) comorbid conditions (e.g., diabetes, hypertension); (3) severity of disease; (4) complications (related to level of kidney function); (5) risk for loss of kidney function; and (6) risk for CVD. Treatment should be initiated according to the patient's stage of disease at diagnosis, as defined by the K/DOQI CKD classification. Table 10 below outlines NKF-recommended clinical action for each stage of disease.

**Table 10. Stages of Chronic Kidney Disease: A Clinical Action Plan**

| Stage | Description | GFR mL/min/1.73 $m^2$ | Action** |
|---|---|---|---|
| 1 | Kidney damage* with normal GFR | 90+ | Diagnosis and treatment, treatment of comorbid conditions, slowing progression, CVD risk reduction |
| 2 | Kidney damage* with mild GFR decrease | 60-89 | Estimating progression |
| 3 | Moderate GFR decrease | 30-59 | Evaluating and treating complications |
| 4 | Severe GFR decrease | 15-29 | Preparation for kidney replacement therapy |
| 5 | Kidney failure | <15 (or dialysis) | Replacement (if uremia present) |

* See page 2 for definition of kidney damage
** Includes actions from preceding stages
Source: NKF K/DOQI Guidelines

**Blood sugar control.** The prevention and management of diabetic nephrology is the key to preventing kidney failure. Tight control of blood glucose has been shown to reduce the development of diabetic nephropathy in both the Diabetes Control and Complications Trial (DCCT) and the United Kingdom Prospective Diabetes Study (UKPDS). In the DCCT, intensive insulin treatments resulted in a 39% reduction in the development of microalbuminuria and a 54% reduction in the development of macroalbuminuria among subjects with type 1 diabetes (14). Results from the UKPDS showed a significant risk reduction for the development of microalbuminuria among people with type 2 diabetes (15).

**Blood pressure control.** The effect of hypertension on the development and progression of CKD is severe, both among diabetic and nondiabetic patients. According to the NKF, blood pressure control has been shown to slow the progression of kidney disease and reduce CVD risk in all demographic and age groups[9]. The American Diabetes Association and the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure have recommended target blood pressure goals for patients with CKD of less than

[8] K/DOQI Clinical Practice Guidelines for Chronic Kidney Disease: Evaluation, Classification, and Stratification. Part 4, Guideline 2.
[9] K/DOQI Clinical Practice Guidelines on Hypertension and Antihypertensive Agents in Chronic Kidney Disease. Guideline 2.

130/80 mm Hg for patients with low levels of proteinuria and 125/75 mm Hg for patients with high levels of protein excretion (16).

Control of blood pressure among patients with CKD usually requires more than one medication to achieve the recommended blood pressure goals; clinical trials suggest that 65% of people with diabetes and hypertension require two or more medications to achieve the goals (17).

ACE inhibitors are first-line agents prescribed for hypertensive patients who are diabetic or who have proteinuria. ARBs are also beneficial and may be used in conjunction with ACEs or in circumstances in which ACEs cannot be used.

Antihypertensive medicines called ACE (angiotensin-converting enzyme) inhibitors are normally the first-line agents prescribed. Agents called ARB (angiotensin-receptor blockers) are also available. Both ACE and ARB inhibitors have strong antiproteinuric and potential cardioprotective effects as well as lowering blood pressure, and have been shown to retard the progression of CKD. Other medications such as diuretics, beta blockers, and calcium-channel blockers may also be used with the goal of achieving and maintaining a blood pressure goal of less than 130/80.

**Dietary Restrictions.** A lower protein intake reduces the amount of urea, a waste product excreted by normal kidneys but retained in the body when kidney function decreases. With less dietary protein, the kidneys do not have to work as hard; this has been shown to slow the progression to kidney failure among diabetic patients with early kidney involvement (18). A diet low in protein, particularly if started in the late stages of CKD, can lead to poor or even malnutrition; thus dietary counseling by a specially trained dietician is important.

Salt-restricted diets help lower blood pressure in some patients with hypertension, while potassium must be restricted if blood levels are high and it is not being excreted normally. High levels of potassium can result in heart rhythm abnormalities. In addition, levels of calcium and phosphorus, two minerals also regulated by the kidneys, can be affected by CKD, resulting in bone problems. Phosphorus levels can become too high, while calcium levels can become too low, requiring medications to bind ingested phosphorus, i.e., "phosphorus binders," and calcium supplements. Because of the delicate balance of minerals maintained by the kidneys, any disruption of function can be serious; for this reason, counsel by a renal dietitian is important.

Obesity may be an independent risk factor for CKD development and progression (19,20). Excess weight is well recognized as a risk factor for diabetes and hypertension as well. Reduction of weight through a dietician-recommended diet and physical activity is important in the management of CKD.

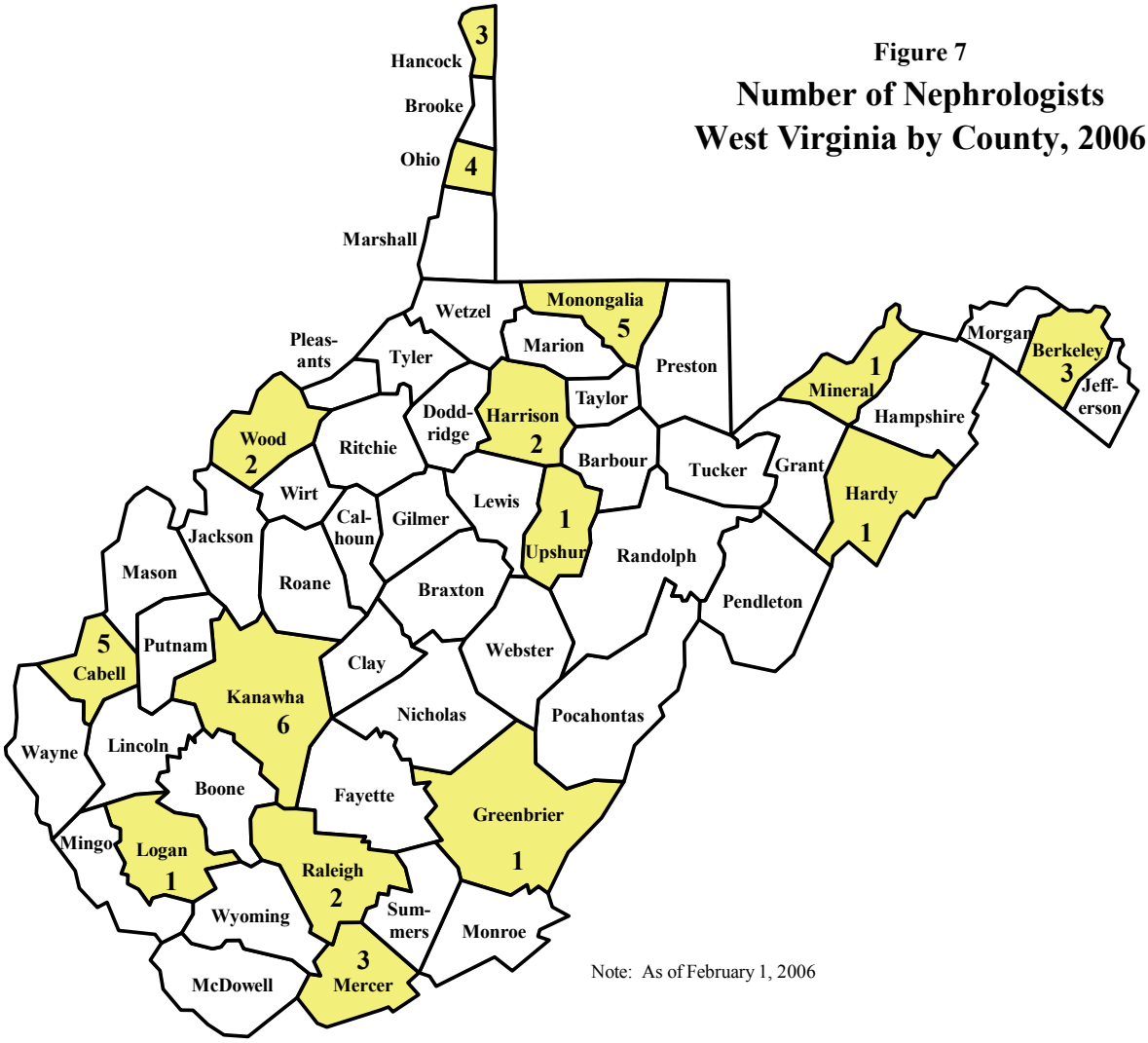
**Other CVD Risk Factors.** In addition to diabetes, hypertension, and obesity, other CVD risk factors such as anemia, high blood cholesterol levels, and smoking need to be addressed and included in treatment plans. Anemia, often accompanied by iron deficiency, begins in CKD and is almost universal among dialysis patients. The anemia of kidney failure has been directly correlated with LVH (21,22). Iron supplementation and erythroprotein-stimulating protein treatment is needed in many CKD patients well before they reach ESRD. Cholesterol-lowering medications may be prescribed, as well as smoking cessation therapies.

**Specialist Referral.** Referral to a nephrologist is recommended by the NKF[10] in general if a patient's GFR is below 30 mL/min/1.73m$^2$. Early referral allows for the development of a clinical action plan designed to address both complications of CKD and those comorbidities that can negatively influence survival. Late evaluation of patients with kidney failure by a nephrologist (less than four months prior to dialysis initiation) has been associated with an increased chance that emergency dialysis, with its attendant costs of hospitalization and temporary catheter placement, will be needed. Late evaluation has also been associated with a shorter duration of survival from dialysis onset (23). As of February 1, 2006, there were 40 nephrology practitioners in West Virginia (see Appendix C). Figure 7 below shows the distribution of nephrologists in West Virginia by county.

> The late referral of CKD patients to a nephrologist is associated with a higher incidence of emergency dialysis and a shorter survival from dialysis onset (22).

**Figure 7**

**Number of Nephrologists**
**West Virginia by County, 2006**




Note: As of February 1, 2006

[10] K/DOQI Clinical Practice Guidelines for Chronic Kidney Disease: Evaluation, Classification, and Stratification. Part 4, Guideline 2.

# II. Prevalence and Incidence of CKD and ESRD

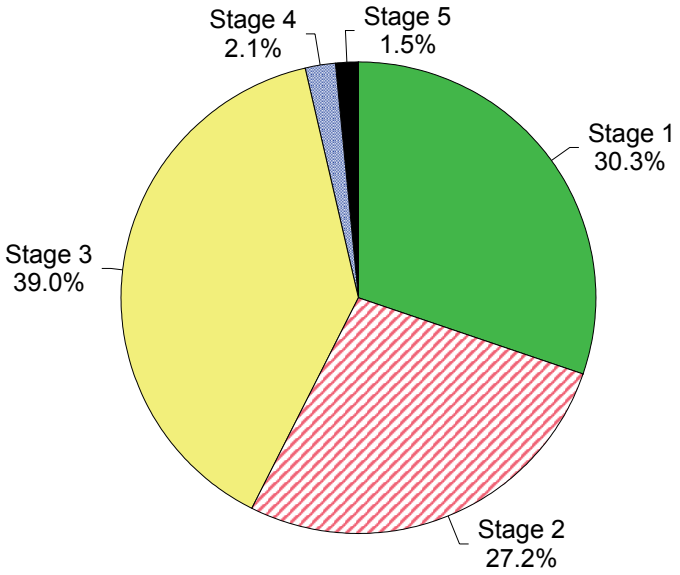
## Prevalence of Chronic Kidney Disease in the United States

The NKF, using 1988-1994 data obtained from the Third National Health and Nutrition Examination Survey (NHANES III), estimated the prevalence of CKD in the US adult population to be 11%, or 19.2 million people (24). In NHANES III, CKD was estimated from a one-time assessment of GFR and albumin level. More than 20 million more adults were estimated to be at increased risk for developing CKD, with most of these unaware of the danger.

Estimates of the prevalence of the five stages of CKD were calculated using the NHANES III data. Among adults aged 20 and older, 3.3% (5.9 million) were estimated to have stage 1 disease (normal GFR with persistent albuminuria), 3.0% (5.3 million) had stage 2 kidney disease (persistent albuminuria with GFR of 60-89), 4.3% (7.6 million) had stage 3 disease (GFR 30-59), 0.2% (400,000) had stage 4 disease (GFR 15-29), and 0.2% (300,000) had stage 5, or kidney failure (GFR <15). Figure 8 below shows the distribution of the stages of CKD among the estimated 19.2 million people who have CKD. Alarmingly, patients with stage 3 CKD are more likely to die than to reach ESRD, explaining the significant drop in prevalence between stages 3 and 4.

A recent NKF investigation found that 90% of people with kidney disease had visited their doctor in the previous year; however, of these, only about one-third were aware of their kidney damage (2). The NKF researchers surveyed over 9,000 people who were examined for kidney disease and asked if they had ever been told they had "weak or failing kidneys."

Figure 8. Distribution of Stages* of CKD among U.S. Adults** with CKD
National Kidney Foundation, 2002




*According to NKF K/DQOI Guidelines definitions
**Aged 20 and older

Approximately 4 out of every 10 people found to have stage 1 disease were unaware of kidney problems, as were 30% of people with stage 2 disease, 22% of those with stage 3 disease, and, most alarmingly, 44% of those diagnosed with stage 4, or severe, disease. The investigators found that African Americans, older people, and those with a history of hypertension were least likely to be aware of their kidney disease.

## Costs of CKD and ESRD in the United States

**ESRD.** The high costs of ESRD have been well documented by the United States Renal Data System (USRDS) in its annual reports. As of December 31, 2002, a total of 431,284 patients had entered the ESRD program in the United States, 308,910 were receiving dialysis treatment and 122,374 had undergone renal transplants (3). The USRDS projects that by 2030 the ESRD population could reach 2.24 million, with 58% of these individuals having diabetes as their primary diagnosis (3)

.

ESRD treatment cost $25.2 billion in 2002, $17 billion of which was covered by Medicare. This represented nearly 7% of total Medicare expenditures in that year. Although ESRD costs represent only about 2%-3% of expenditures by employer group health plans (EGHP), these costs are increasing at a faster rate than Medicare costs. Per-person-per-year costs for ESRD patients enrolled in EGHPs were $72,450 in 2003, compared with $54,904 among Medicare patients, even though the EGHP patients were on average 20 years younger than Medicare patients (25).

The largest portion of Medicare ESRD expenditures in 2003 were spent on dialysis, i.e., $14.8 billion, compared with $0.8 billion spent on transplants. The highest costs were incurred by patients with comorbidities. Costs for patients with congestive heart failure and diabetes were 59% higher than those for patients without either diagnosis and 39% higher than costs for patients with diabetes alone (25).

A study by Trivedi et al. published in the *American Journal of Kidney Disease* in 2002 used USRDS data to estimate the economic benefits of slowing the progression to ESRD between 2000 and 2010 (26). The authors projected cumulative savings of $18.6 billion, $39 billion, and $60.6 billion for 10%, 20%, and 30% decreases, respectively, in the rate of decline in GFR among patients with GFRs of 60mL/min or less. For the same decreases among patients with GFRs of 30mL/min or less, the cumulative savings through 2010 would equal $9 billion, $20 billion, and $33.4 billion, respectively.

**CKD.** Data from the Kaiser Permanente Northwest Region health maintenance organization were used to analyze costs associated with CKD before ESRD (stages two through four) (11). Patients with CKD and no comorbidities had medical costs averaging $18,000 over the five-year study period, compared with $9,800 among non-CKD patients with no morbidities. Depending upon stage of CKD, CKD patients had 1.9 to 2.5 times more prescriptions and 1.3 to 1.9 times more outpatient visits, were 1.6 to 2.2 times more likely to have an in-patient stay, and had 1.8 to 3.1 more stays than non-CKD patients. Comorbidities associated with CKD were more costly to treat and manage than those among patients without CKD.

## Incidence and Prevalence of ESRD in WV and the US

A recent study used historical data on the ESRD population to project the growth of ESRD in the United States through 2010 (27). Using forecasting models, the authors estimated an average annual growth of 4.1% for new ESRD patients, 6.4% for total ESRD patients, 7.1% for dialysis patients, 6.1% for functioning transplant patients, and 8.2% for patients on waiting lists for transplants.

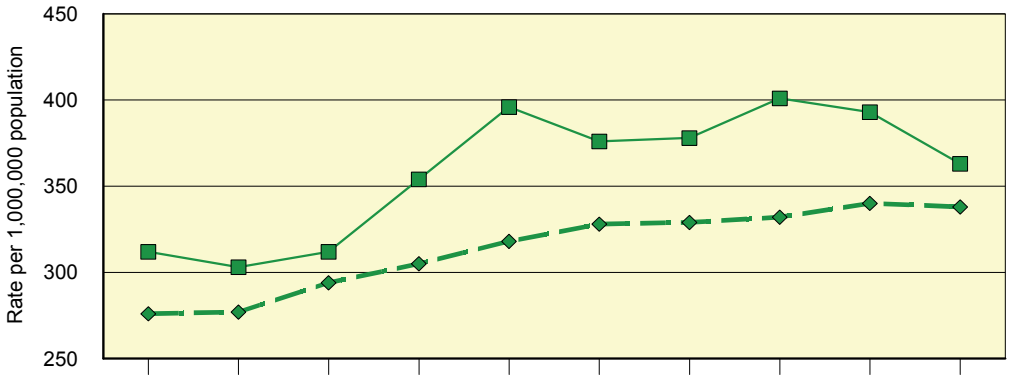
While state-specific estimates of CKD are unavailable at this time, state-specific ESRD data are published by the USRDS, using data obtained by ESRD Network Organizations. The USRDS collects data on both the incidence (the number of new cases of ESRD reported within a calendar year) and prevalence (total number of people living with ESRD within a calendar year, regardless of when they were diagnosed). For the purposes of this report, incidence and prevalence rates were examined for the 10 years from 1994 through 2003 in both West Virginia and the United States.

Incidence and prevalence rates are presented for all patients diagnosed with ESRD, as well as ESRD patients with diabetes and ESRD patients without diabetes. The rates are calculated as number of new cases (incidence) and all cases (prevalence) per 1,000,000 population and are adjusted by age, gender, and race to the 2002 U.S. Census population for comparability.

For all patients, the rate of ESRD incidence has consistently been higher in West Virginia than in the United States as a whole over the 10-year period, as shown in Figure 9. ESRD prevalence rates, on the other hand, were higher in the nation than in the state from 1994 through 2000, when the state's rate surpassed the national one (Figure 10). While West Virginia's rates for all patients have been higher since 2001, the difference is slight.

When ESRD rates are examined by diabetes status, an interesting pattern is revealed. State rates for both ESRD incidence (Figure 11) and prevalence (Figure 12) among patients with diabetes have increased at a greater rate than those for the nation. For those patients without diabetes, however, no pattern is discernible among state incident rates although a slight increase is evidenced nationwide (Figure 13), while prevalence rates have consistently risen in the state and the nation, with national rates higher over the entire period than state rates, although the gap appears to be lessening (Figure 14). As the graphics on pages 20-22 show, the larger increases in total ESRD rates in the state over the 10-year period have been driven by rates for those patients with diabetes, particularly relevant in West Virginia because of the high prevalence of the disease among state residents.

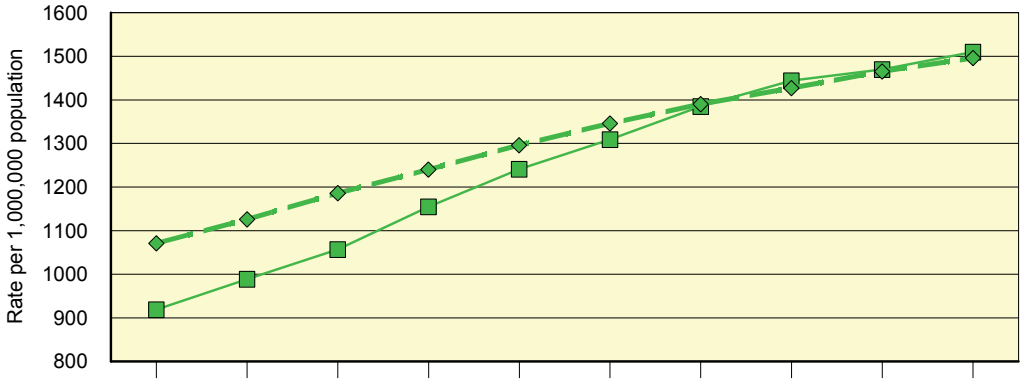
Figure 9. Incident rates* of reported ESRD, all patients
West Virginia and United States, 1994-2003




| | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|---|---|---|---|---|---|---|---|---|---|
| WV | 312 | 303 | 312 | 354 | 396 | 376 | 378 | 401 | 393 | 363 |
| US | 276 | 277 | 294 | 305 | 318 | 328 | 329 | 332 | 340 | 338 |

*Rates adjusted by age, gender, and race to 2002 U.S. Census standard population
Source: USRDS

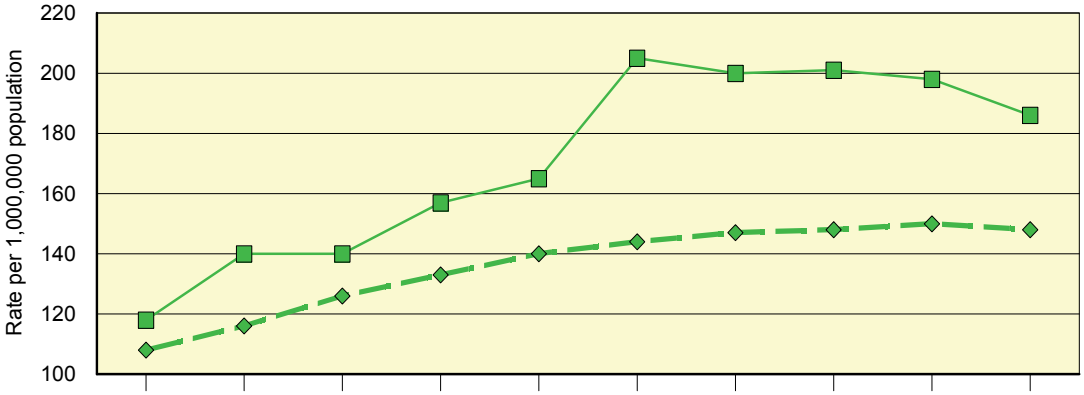
Figure 10. Prevalence rates* of reported ESRD, all patients
West Virginia and United States, 1994-2003




| | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|---|---|---|---|---|---|---|---|---|---|
| WV | 919 | 989 | 1057 | 1155 | 1241 | 1309 | 1385 | 1444 | 1470 | 1510 |
| US | 1071 | 1126 | 1186 | 1240 | 1296 | 1346 | 1390 | 1427 | 1465 | 1496 |

*Rates adjusted by age, gender, and race to 2002 U.S. Census standard population
Source: USRDS

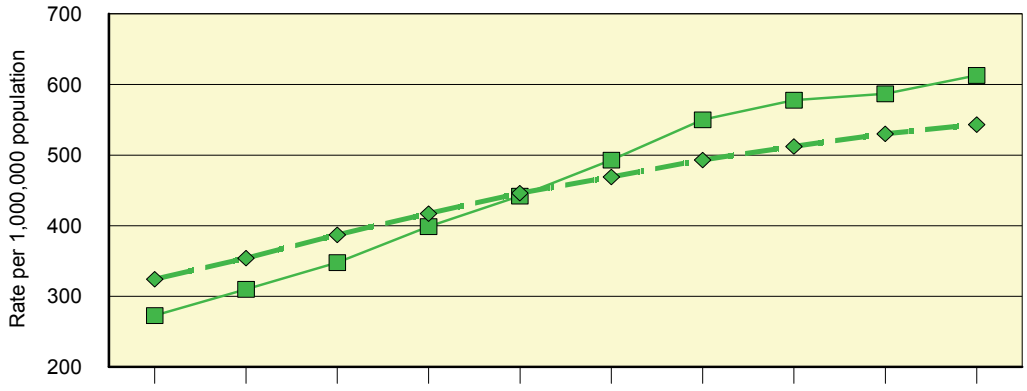
Figure 11. Incident rates* of reported ESRD, patients with diabetes
West Virginia and United States, 1994-2003




| | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|---|---|---|---|---|---|---|---|---|---|
| WV | 118 | 140 | 140 | 157 | 165 | 205 | 200 | 201 | 198 | 186 |
| US | 108 | 116 | 126 | 133 | 140 | 144 | 147 | 148 | 150 | 148 |

*Rates adjusted by age, gender, and race to 2002 U.S. Census standard population
Source: USRDS

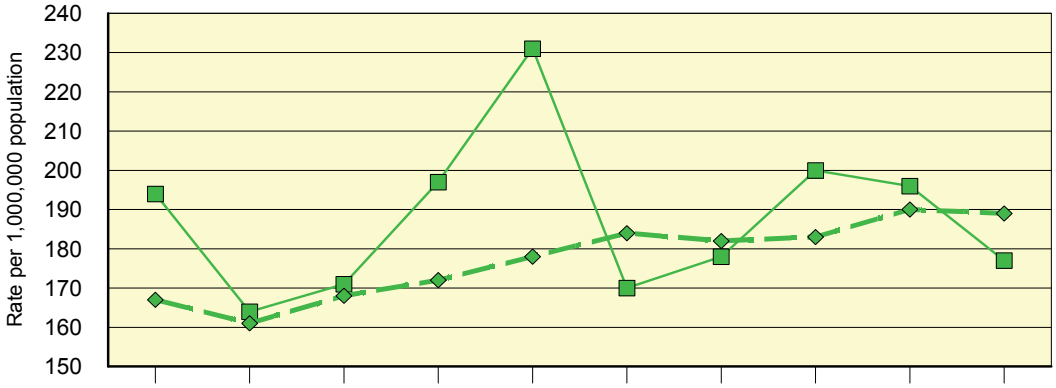
Figure 12. Prevalence rates* of reported ESRD, patients with diabetes
West Virginia and United States, 1994-2003




| | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|---|---|---|---|---|---|---|---|---|---|
| WV | 273 | 310 | 348 | 399 | 442 | 493 | 550 | 578 | 587 | 613 |
| US | 324 | 354 | 387 | 417 | 446 | 469 | 493 | 512 | 530 | 543 |

*Rates adjusted by age, gender, and race to 2002 U.S. Census standard population
Source: USRDS

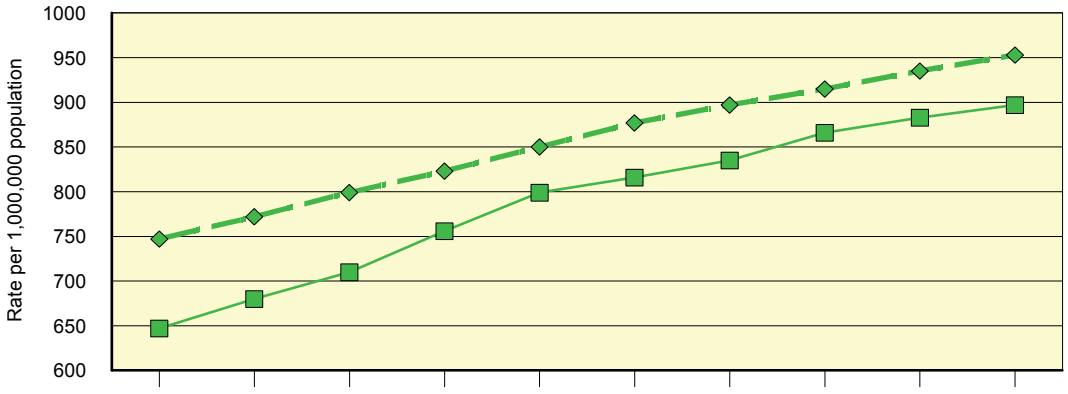
Figure 13. Incident rates* of reported ESRD, patients without diabetes
West Virginia and United States, 1994-2003




| | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|---|---|---|---|---|---|---|---|---|---|
| WV | 194 | 164 | 171 | 197 | 231 | 170 | 178 | 200 | 196 | 177 |
| US | 167 | 161 | 168 | 172 | 178 | 184 | 182 | 183 | 190 | 189 |

*Rates adjusted by age, gender, and race to 2002 U.S. Census standard population
Source: USRDS

Figure 14. Prevalence rates* of reported ESRD, patients without diabetes
West Virginia and United States, 1994-2003




| | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|---|---|---|---|---|---|---|---|---|---|
| WV | 647 | 680 | 710 | 756 | 799 | 816 | 835 | 866 | 883 | 897 |
| US | 747 | 772 | 799 | 823 | 850 | 877 | 897 | 915 | 935 | 953 |

*Rates adjusted by age, gender, and race to 2002 U.S. Census standard population
Source: USRDS

# III. Screening for Chronic Kidney Disease

The NKF's Kidney Early Evaluation Program (KEEP) is a community-based detection program that screens volunteer participants for kidney function and CKD risk factors. The program focuses on those individuals at high risk for CKD, i.e., having been diagnosed with diabetes or hypertension or having a family history of CKD, diabetes, or hypertension. KEEP began as a pilot project in 21 cities in 1997, expanding to a national initiative in 2000 through the NKF's local affiliates. The 2005 KEEP annual data report indicates that to date over 50,000 individuals have been screened nationwide, evaluated for blood pressure, height, weight, BMI, family history of diabetes, CKD, CVD, or hypertension, evidence of anemia, and evidence of kidney damage through albumin and serum creatinine testing. KEEP screening sites continue to increase across the country.

## 2005 National KEEP Screening Data

By 2005, 37,155 individuals nationwide had met the KEEP entry criteria of a known history of diabetes or hypertension or a family history of diabetes, hypertension, or kidney disease (28). When compared with the 1999-2002 NHANES population, KEEP participants were more likely to be older, female, and African American. Diabetes was self-reported by one-fourth (25%) of participants; overall, however, 30% were found to have diabetes, determined either by self-reporting or through KEEP testing. Over one-half (52%) of participants self-reported hypertension, whereas 72% of participants were found to have high blood pressure during the screenings. Sixteen percent (16%) of participants reported a history of CVD; this increased to 32% of participants aged 76 and older.

> "Fifty percent of the people participating in the KEEP program are in some stage of CKD, yet only 3 percent are aware that they have the problem."
>
> Monica Gannon
> National Kidney Foundation

Sixteen percent (16%) of participants were found to have stage 1 CKD, 22% had stage 2 CKD, and 15% had stage 3 CKD, as defined by the NKF guidelines. The occurrence of CKD rose with age and was higher among African-American participants. Nearly one-fourth (24%) of KEEP participants with CKD had a family history of kidney disease, 26% of women and 19% of men. Participants with CKD were more likely to report a history of CVD than those without CKD.

## West Virginia KEEP Screening Participation

The NKF's KEEP detection program is conducted through the organization's local affiliates. West Virginia's counties are currently divided among three local NKF affiliates: 8 eastern counties are affiliated with NKF of Maryland, 14 northern counties are affiliated with NKF of the Alleghenies, and the remaining 33 counties are affiliated with NKF of the Virginias. A map showing these affiliations can be found in Appendix D. KEEP screening was first initiated in West Virginia in 2004 through NKF of the Virginias. In 2004-2005, a total of 620 individuals were evaluated through KEEP during 12 screenings at eight different locations in the state, providing limited data.

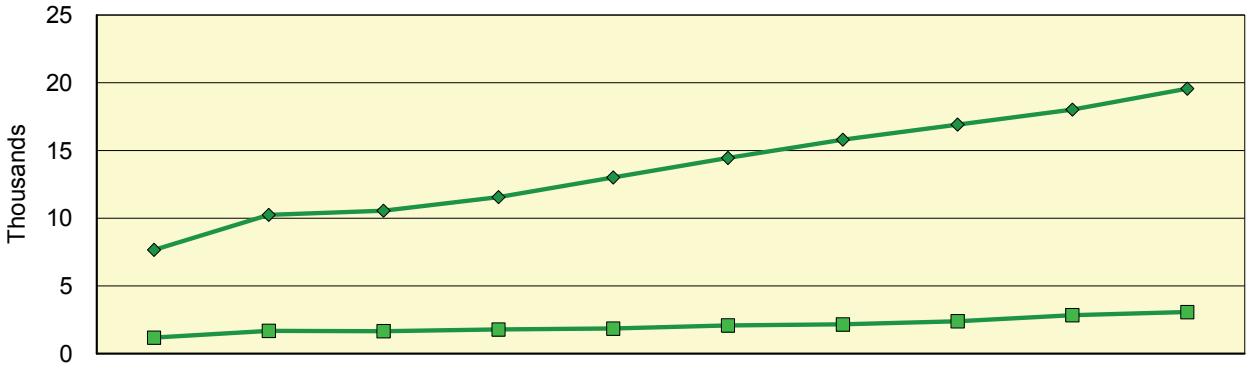
Additional screenings through NKF of the Alleghenies are planned for 2006, with up to 550 additional participants. Adding these participants to the 620 previously evaluated will afford a sufficiently large database to begin analysis of the characteristics of and CKD occurrence among state participants.

# IV. Kidney Disease Hospitalizations

Hospital discharge data are used to provide additional information on the prevalence of disease and the financial burden it places upon the state. Discharge data from the West Virginia Health Care Authority (WVHCA) were used to examine a 10-year trend in inpatient hospitalizations for kidney disease[11] among West Virginia residents in West Virginia hospitals, both as a principal and a secondary diagnosis.[12]

**1995-2004 Hospitalizations.** Over the decade from 1995 through 2004, the number of hospitalizations with a principal diagnosis of kidney disease increased 160%, from 1,183 in 1995 to 3,076 in 2004, while the number of discharges with a secondary diagnosis of kidney disease increased 155%, from 7,671 in 1995 to 19,571 in 2004. Figure 15 illustrates the increase in hospitalizations having either a principal or secondary diagnosis of CKD, an indication of the rising prevalence of kidney disease in the state. Discharges with any diagnosis of kidney disease (principal or secondary) accounted for 4.0% of all inpatient hospital discharges in 1995; this had increased to 8.9% of all discharges by 2004.

Figure 15. Number of hospital discharges having kidney disease* as either a principal or secondary diagnosis
West Virginia, 1995-2004




| | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 |
|---|---|---|---|---|---|---|---|---|---|---|
| Principal | 1183 | 1696 | 1666 | 1798 | 1859 | 2093 | 2172 | 2398 | 2847 | 3076 |
| Secondary | 7671 | 10250 | 10564 | 11564 | 13010 | 14455 | 15804 | 16918 | 18025 | 19571 |

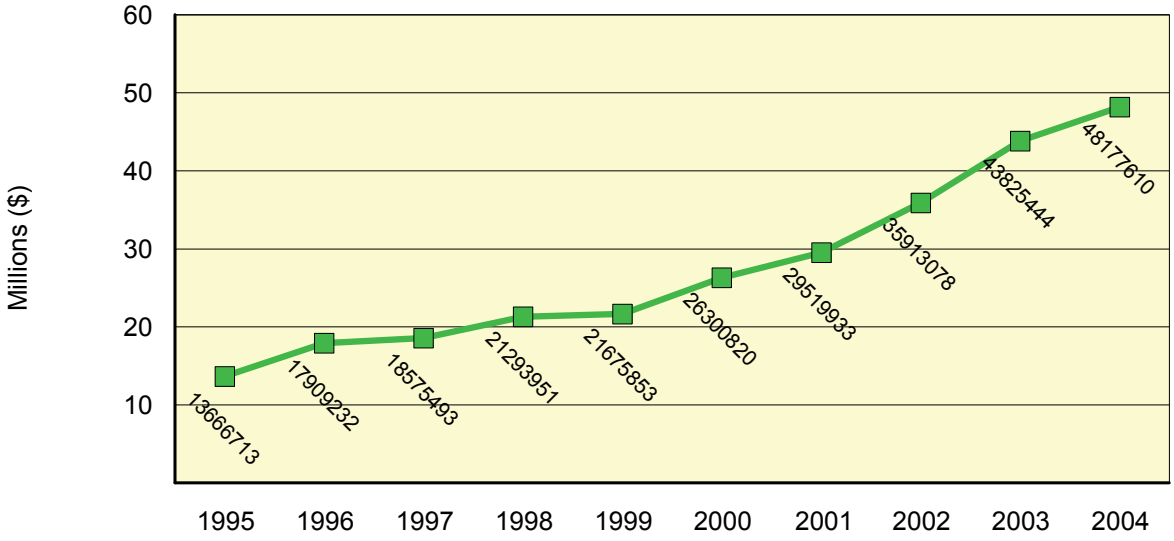
*ICD-9-CM codes 250.4, 403, 580-589, 753
Source: WVHCA

[11] ICD-9-CM codes 250.4, 403, 580-589, 753

[12] The WVHCA collects inpatient data from all nonfederal licensed hospitals in the state and Medicare data on West Virginia residents hospitalized in out-of-state hospitals. Up to nine diagnoses (one principal and eight secondary) are recorded and coded according to the International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM).

In 1995, the charges for hospital discharges with a principal diagnosis of kidney disease totaled $13,667,000. By 2004, these charges had risen to $48,178,000, an increase of 253% over the decade. The average charge per discharge increased from $11,553 to $15,662. Figure 16 shows the upward trend in charges for kidney disease in West Virginia hospitals from 1995-2004. Charges for discharges with a principal diagnosis of kidney disease accounted for 1.5% of total billed charges in 2004, up from 0.7% in 1995.

Figure 16. Total charges for hospital discharges having kidney disease* as a principal diagnosis West Virginia, 1995-2004

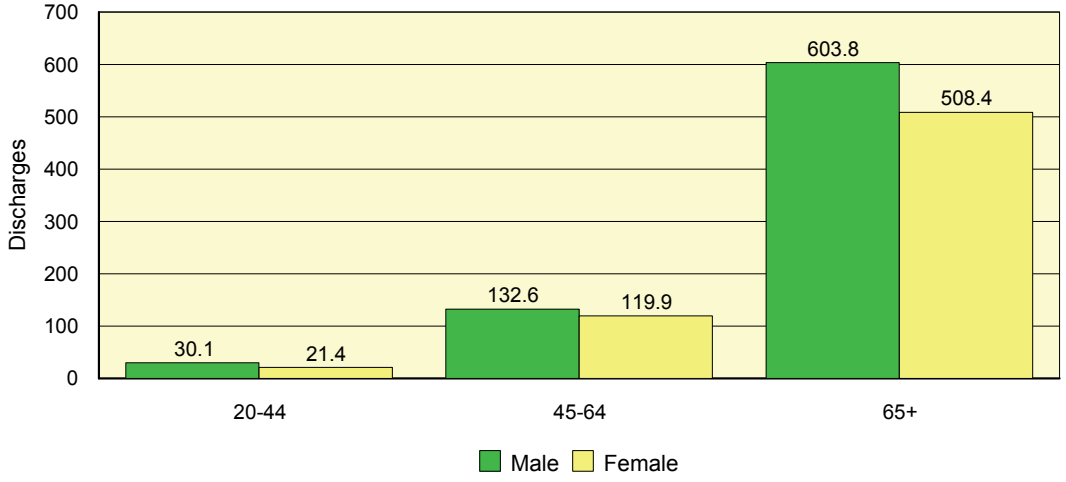



*ICD-9-CM codes 250.4, 403, 580-589, 753.1, 55.69
Source: WVHCA

**2004 Hospitalization Rates.** In 2004, the overall rate of hospitalizations having either a principal or secondary diagnosis of kidney disease was 124.8 discharges per 10,000 population. The rate was similar for men and women, 122.3 among men and 127.1 among women. By age, the highest rate (603.8) was found among men aged 65 and older, the lowest (21.4) among women aged 20-44 (Figure 17).

Hospitalization rates for discharges with any kidney disease diagnosis ranged from a high of 270.1 discharges per 10,000 population among residents of Logan County to a low of 10.7 among residents of Hampshire County. Figure 18 on the following page illustrates the county rates; individual county rates are found in Appendix E.

Figure 17. Rate of hospital discharges having kidney disease* as either a principal or secondary diagnosis by gender and age
West Virginia, 2004



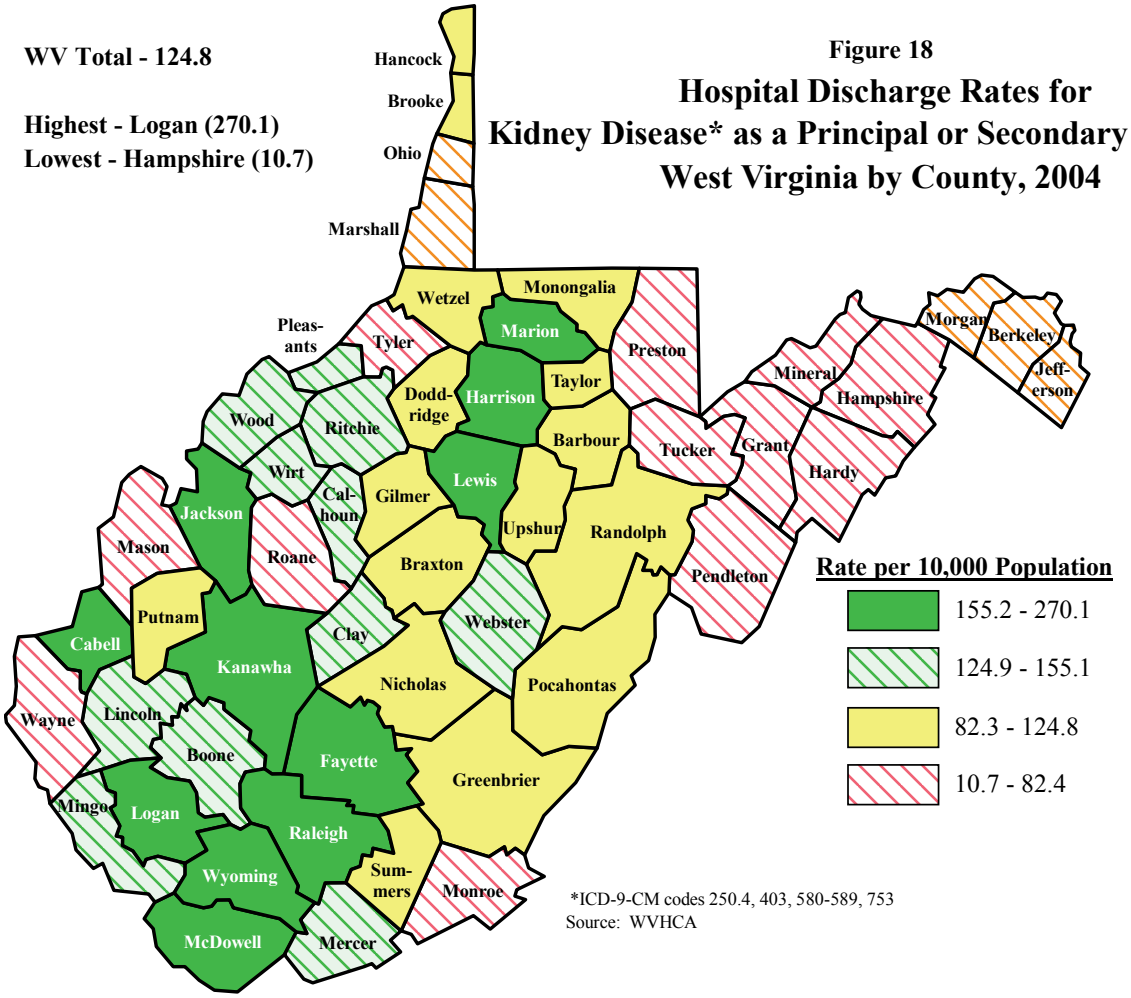

*ICD-9-CM codes 250.4, 403, 580-589, 753
Rate per 10,000 population
Source: WVHCA

**Figure 18**

**Hospital Discharge Rates for Kidney Disease* as a Principal or Secondary Diagnosis West Virginia by County, 2004**

**WV Total - 124.8**

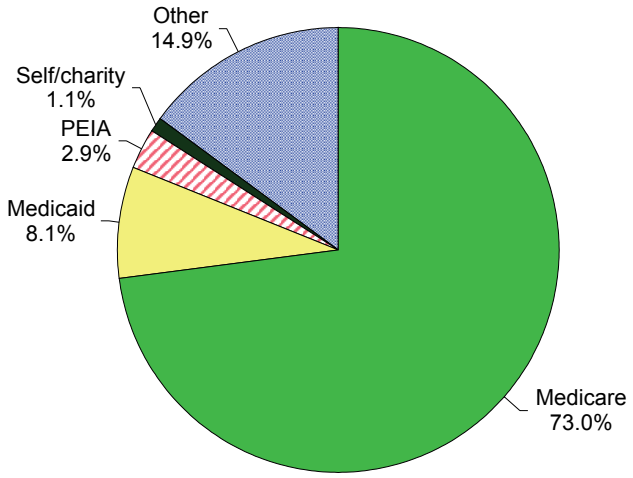
**Highest - Logan (270.1)**
**Lowest - Hampshire (10.7)**




*ICD-9-CM codes 250.4, 403, 580-589, 753
Source: WVHCA

The largest portion of charges for 2004 hospitalizations due to a principal diagnosis of kidney disease were billed to Medicare (73%), followed by private insurance plans (15%) and Medicaid (8%). Figure 19 below shows the distribution of charges by payer.

Figure 19. Total charges for discharges with a principal diagnosis of kidney disease*
Distribution by payer
West Virginia, 2004




*ICD-9-CM codes 250.4, 403, 580-589, 753.1, 55.69
Source: WVHCA

# V. Dialysis and Transplantation in West Virginia

**Dialysis.** There are two types of dialysis: hemodialysis and peritoneal dialysis. During hemodialysis, the patient's blood passes from the body into the dialysis machine, where it circulates along a filter called a dialysis membrane or dialyzer, along with special dialysis fluid. Waste products such as urea and creatinine and excess water are diffused through the filter into the dialysis fluid and discarded, and the filtered blood is returned to the body. Hemodialysis is generally performed at a dialysis center three or four times weekly. Many patients can also safely perform home hemodialysis. Emerging techniques that facilitate the use of daily or nocturnal hemodialysis may be particularly beneficial for West Virginians who live in rural areas, often a considerable distance from the nearest dialysis facility. Benefits of home dialysis include improved patient satisfaction and survival, as well as other measures of successful rehabilitation.

Peritoneal dialysis requires that a plastic tube called a dialysis catheter be placed through the abdominal wall into the abdominal cavity. The dialysis fluid is infused into the space surrounding the bowel, where it remains for several hours before drainage and instillation of new fluid. During these hours, waste products and excess fluid are removed from the patient's body and discarded with the drained solution. This type of dialysis is usually performed at home with the specifics of technique and number of treatments dependent on the individual patient. Peritoneal dialysis can be performed either during waking hours or while patients sleep, making this an excellent choice of dialysis modality for some patients. Data on dialysis patients presented in this section were provided by the USRDS and the Mid-Atlantic Renal Coalition (MARC)[13]. MARC collects data on ESRD and dialysis patients in West Virginia, Virginia, Maryland, and the District of Columbia (Network 5). According to the 2005 MARC data report, as of December 31, 2004, there were 24 dialysis centers operating in West Virginia (Figure 20).

The number of dialysis patients in West Virginia increased by 75% from 1993 to 2004, from 929 to 1,625. Figure 21 on the following page shows the upward trend in dialysis patients over the period. According to MARC data, of the 1,625 dialysis patients treated in 2004, 55% were men and 45% were women, comparable to the overall Network 5 breakdown of 54% and 46%, respectively. Nearly 9 out of every 10 (87%) state dialysis patients were receiving hemodialysis at a dialysis center, compared with about 91% network-wide. Dialysis recipients in West Virginia in 2004 tended to be somewhat older than those in Network 5 as a whole, with 47% of state patients aged 65 and older, compared with 42% in the network (Figure 22, page 31). Thirteen percent (13%) of dialysis patients in the state were African-American[14], compared with 60% of those in the overall network. There were marked differences between West Virginia and Network 5 in the primary diagnosis leading to dialysis. In the state, nearly one-half (49%) of patients had a primary diagnosis of diabetes and 24% of hypertension. In the network, diabetes accounted for 39% of primary diagnoses and hypertension accounted for 34%. Figure 23 on page 31 illustrates the differences in the distribution of primary diagnoses.

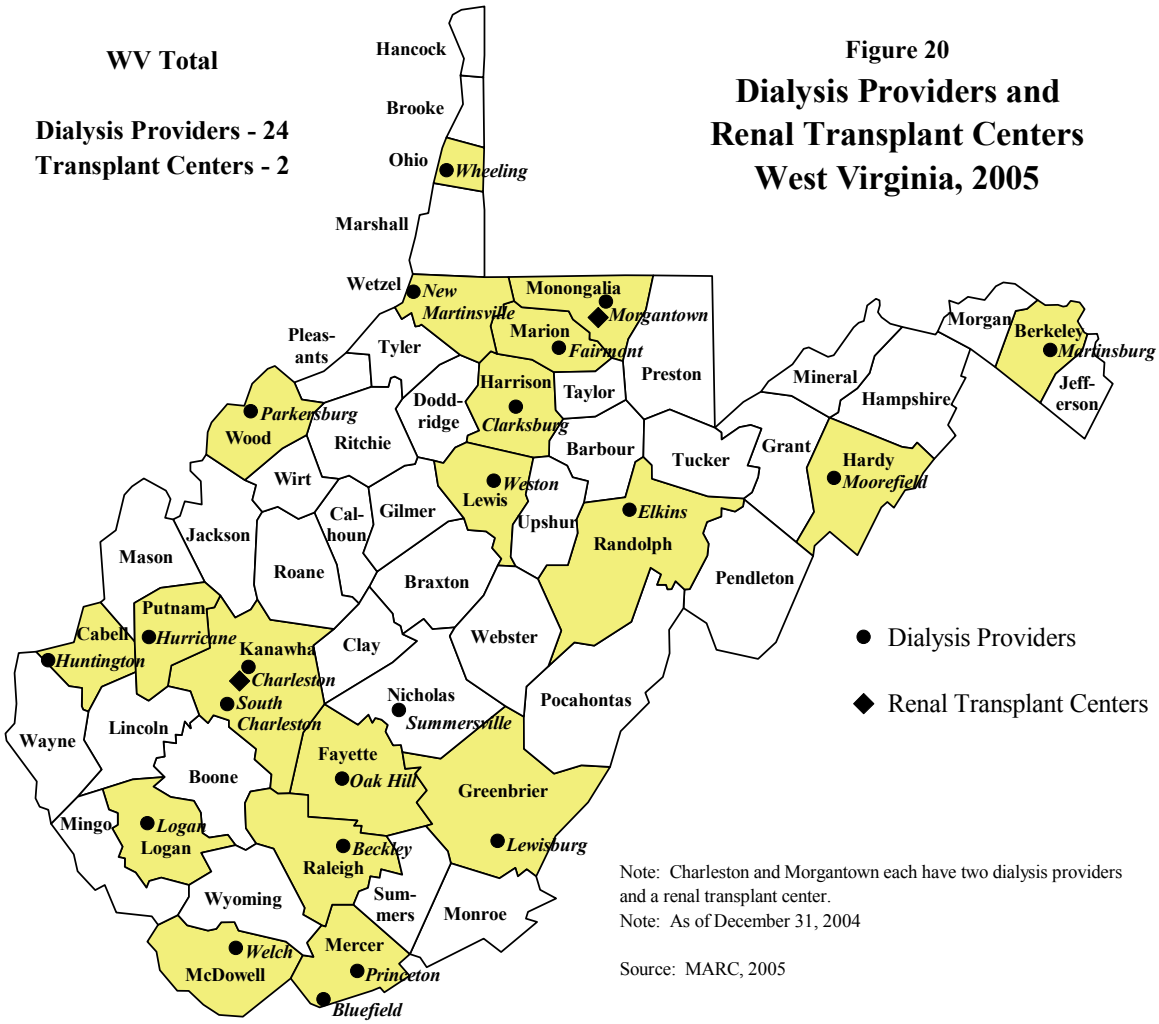
[13] MARC is one of 18 Medicare-funded ESRD Network Organizations in the United States responsible for monitoring the quality of care delivered to patients with ESRD.

[14] African-Americans account for only 3.2% of West Virginia's total population, according to the 2000 census.

**WV Total**

**Dialysis Providers - 24**
**Transplant Centers - 2**

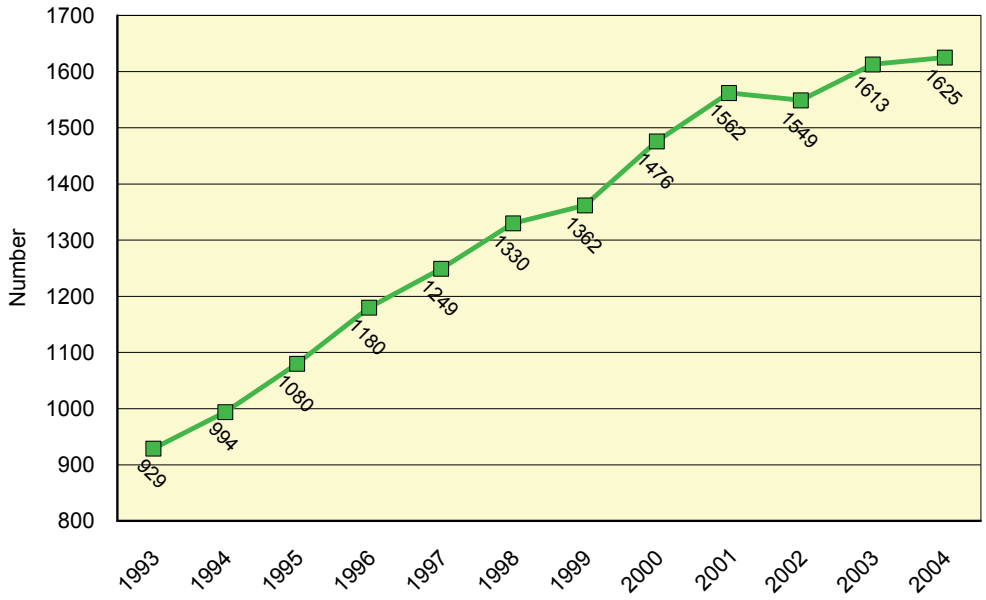
**Figure 20**
**Dialysis Providers and Renal Transplant Centers West Virginia, 2005**




Note: Charleston and Morgantown each have two dialysis providers and a renal transplant center.
Note: As of December 31, 2004

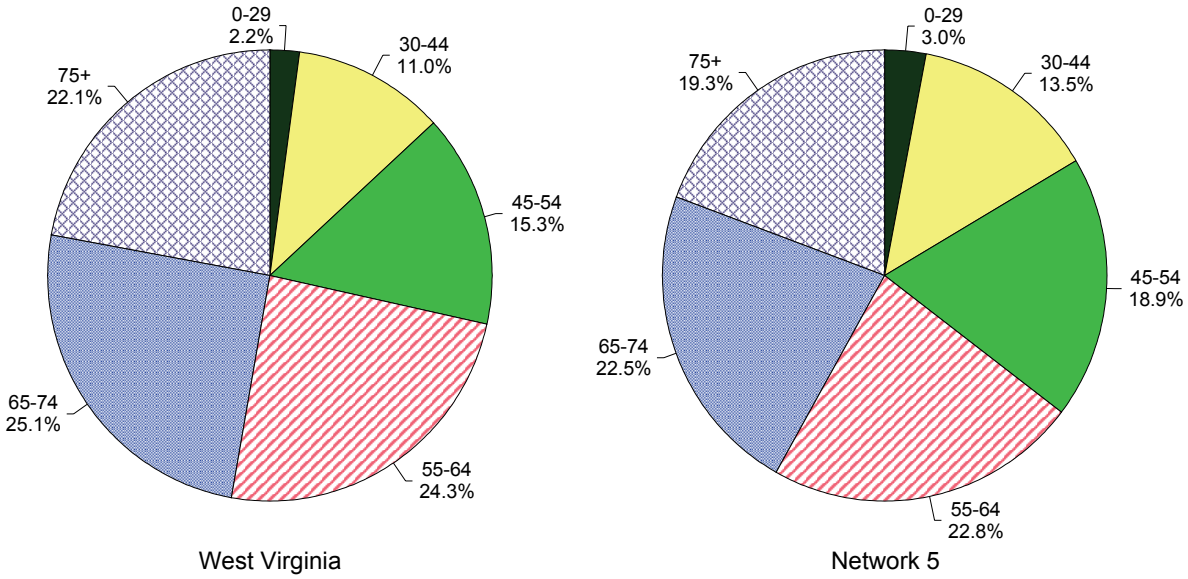
Source: MARC, 2005

Figure 21. Number of dialysis patients West Virginia residents, 1993-2004



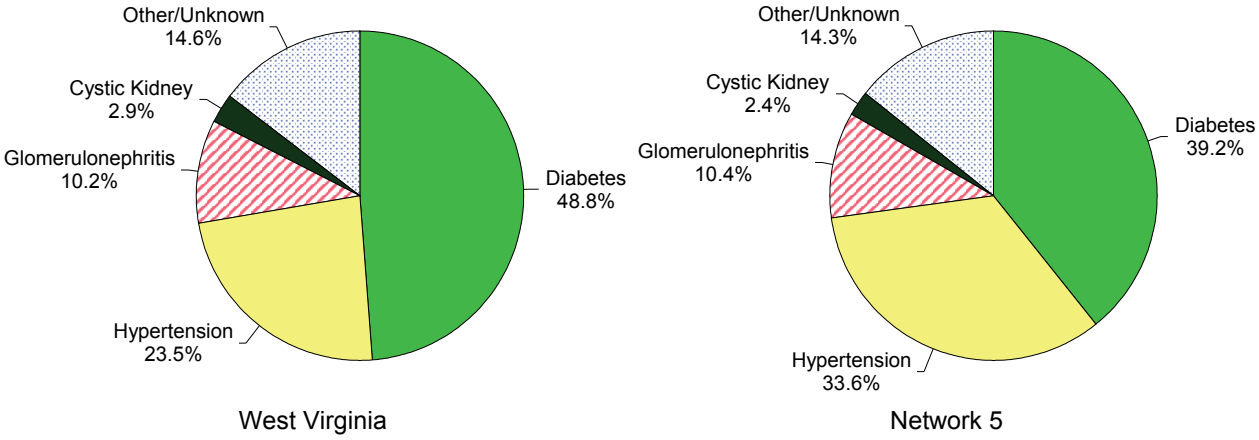

Sources: USRDS, 1993-2003; MARC, 2004

Figure 22. Distribution of Dialysis Patients by Age
West Virginia and ESRD Network 5*, 2004




*Network 5: District of Columbia, Maryland, Virginia, West Virginia (includes 346 patients from other states)
Source: MARC, 2005

Figure 23. Distribution of Dialysis Patients by Primary Diagnosis
West Virginia and ESRD Network 5*, 2004




*Network 5: District of Columbia, Maryland, Virginia, and West Virginia (includes 346 patients from other states)
Source: MARC, 2005

**Transplants**. Kidney transplantation is the surgical implantation of a healthy kidney from a donor. The new kidney is attached to one of the renal arteries and renal veins and to the ureter, which carries the urine to the bladder. The transplanted kidney, called a "graft," carries out all the functions the failing kidneys are unable to perform, eliminating the need for dialysis. There are two types of kidneys transplants: those that come from living donors (either related or nonrelated) and those that are obtained from nonliving donors (cadaveric kidneys). Individuals waiting for a cadaveric kidney are registered with the Organ Procurement and Transplantation Network[15] (OPTN), which maintains a centralized computer network linking all regional organ procurement organizations and transplant centers.

Suitability for a donated kidney is based on blood type and human leukocyte antigen (HLA) factors, a genetic marker on the white blood cells. The donee's immune system is also tested for antibodies against the donor's tissues to determine if a negative reaction will occur. Following a transplant, the patient must take immunosuppressant drugs to prevent rejection of the new organ. If a new kidney is rejected, however, patients will require dialysis before another transplant can be performed. Lack of available donors or complex immune reactions may make subsequent transplants more complicated.

West Virginia has two renal transplant centers: West Virginia University Hospital in Morgantown and Charleston Area Medical Center (see Figure 20, page 30), but many state residents undergo transplantation at centers in nearby states. According to MARC data, 65 transplants were performed in the state in 2003 and 50 were performed in 2004; the total number of living transplant patients in West Virginia in 2004 was approximately 700.

[15] The OPTN is administered by the United Network for Organ Sharing under a contract with the federal government.

# VI. Kidney Disease Mortality

According to data from the West Virginia Health Statistics Center (WVHSC), there were 568 deaths among state residents due to kidney disease[16] in 2004, 244 deaths among men and 324 deaths among women. The overall age-adjusted rate of kidney disease mortality was 26.9 deaths per 100,000 population, with a male rate of 30.9 and a female rate of 25.1. The majority of deaths were attributed to renal failure (443, or 78%), with 112 (20%) a result of hypertension with renal disease. Most of the deaths (467, or 82%) occurred among West Virginians aged 65 and older.

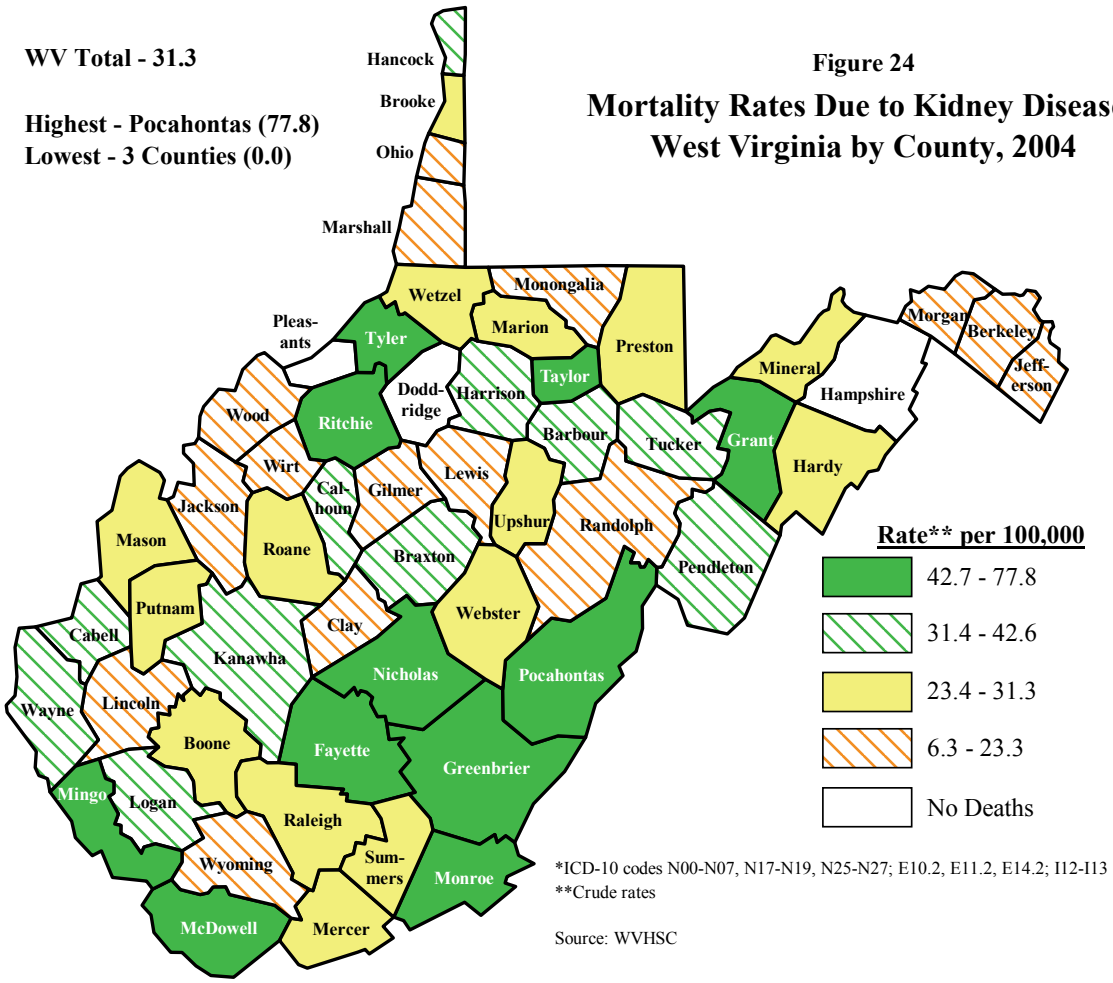
Figure 24 illustrates 2004 kidney disease mortality crude rates by county. The highest rates were reported in the southern counties of the state, with Pocahontas County having the highest rate at 77.8. Three counties (Doddridge, Pleasants, and Hampshire) reported no kidney disease mortality in 2004. Individual county rates are found in Appendix F.

**WV Total - 31.3**

**Highest - Pocahontas (77.8)**
**Lowest - 3 Counties (0.0)**

**Figure 24**

**Mortality Rates Due to Kidney Disease***
**West Virginia by County, 2004**



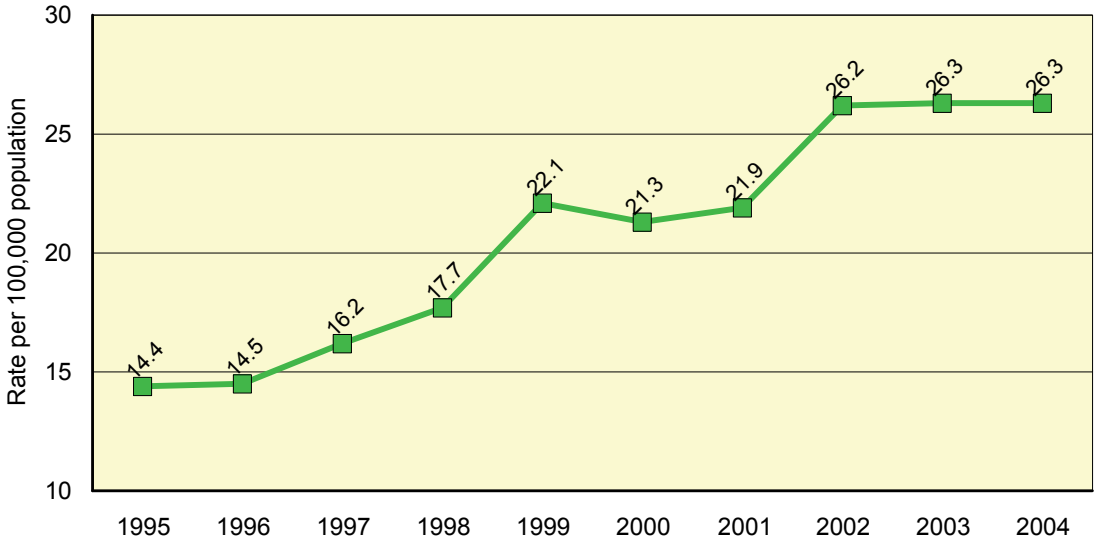

*ICD-10 codes N00-N07, N17-N19, N25-N27; E10.2, E11.2, E14.2; I12-I13
**Crude rates

Source: WVHSC

[16] Kidney disease mortality is defined in this report as deaths occurring as a result of nephritis, nephritic syndrome, and nephrosis (ICD-10 codes N00-N07, N17-N19, N25-N27), diabetes with renal complications (E10.2, E11.2, E14.2), and hypertensive renal disease and hypertensive heart and renal disease (I12, I13).

Figure 25 shows the upward trend in kidney disease mortality[17] in West Virginia during the decade between 1995 and 2004. The overall rate increased 83%, from 14.4 deaths per 100,000 population in 1995 to 26.3 in 2004. The rate among men increased 74%, from 17.6 in 1995 to 30.6 in 2004, while the rate among women increased 91%, from 12.7 in 1995 to 24.3 in 2004.

Figure 25. Mortality rates due to kidney disease* by year
West Virginia, 1995-2004




*ICD-9 codes (1995-1998) 403, 580-589, 753.1; ICD-10 codes (1999-2004) N00-N07, N17-N19, N25-N27, I12-I13
NOTE: Rates are age-adjusted to the 2000 U.S. standard million.

**Multiple-Cause-of-Death Data**. The National Center for Health Statistics (NCHS) compiles and collects data on all deaths in the United States according to ICD-10 coding. The information is released by the NCHS on an annual basis and includes the following: decedent's gender, age, race, and state of residence; the underlying (principal) cause of death, and any contributing causes of death (up to 19). Because of the association between CKD and CVD and their shared risk factors, this report examines multiple-cause-of-death data related to kidney disease[18] and CVD as underlying and contributing causes of death for West Virginia and the United States for 2002, the latest available NCHS data.

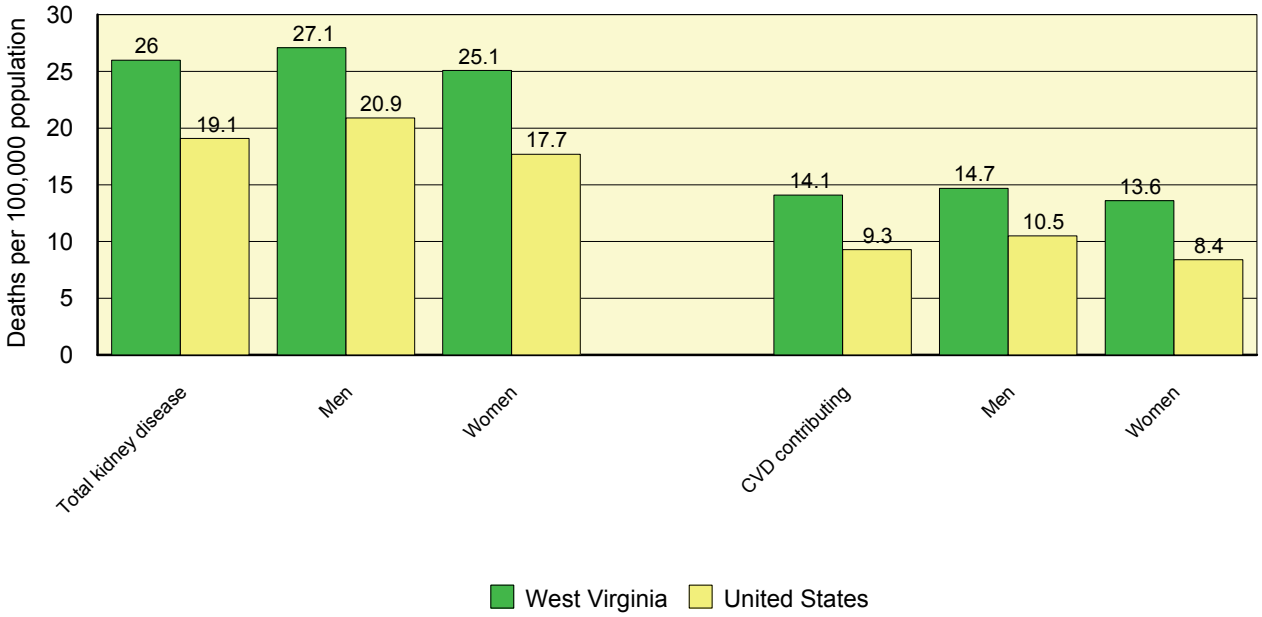
In that year, the state had higher age-adjusted rates of kidney disease mortality than the nation, both overall (26.0 deaths per 100,000 population vs. 19.1) and among both sexes (27.1 vs. 20.9 and 25.1 vs. 17.7 among men and women, respectively). Nationally, nearly one-half (48.5%) of all deaths attributed to kidney disease also had a contributing cause of CVD noted on

[17] Although included in the rates given for 2004 on the preceding page, deaths due to diabetes with renal complications were not used in calculating mortality trend rates depicted in Figure 25 because of inconsistencies resulting from ICD coding changes between 1998 and 1999 (ICD-9 to ICD-10). However, because of the small numbers of these deaths (e.g., only 12 in 2004), this omission resulted in little change in the overall rates of kidney disease mortality over the 10-year period.
[18] See note 16.

the death certificate, while in West Virginia more than half (54.2%) of kidney disease deaths had CVD listed as a contributing cause. Figure 26 illustrates the difference in rates in the state and the nation for total kidney disease mortality and those deaths from kidney disease with a contributing CVD diagnosis.

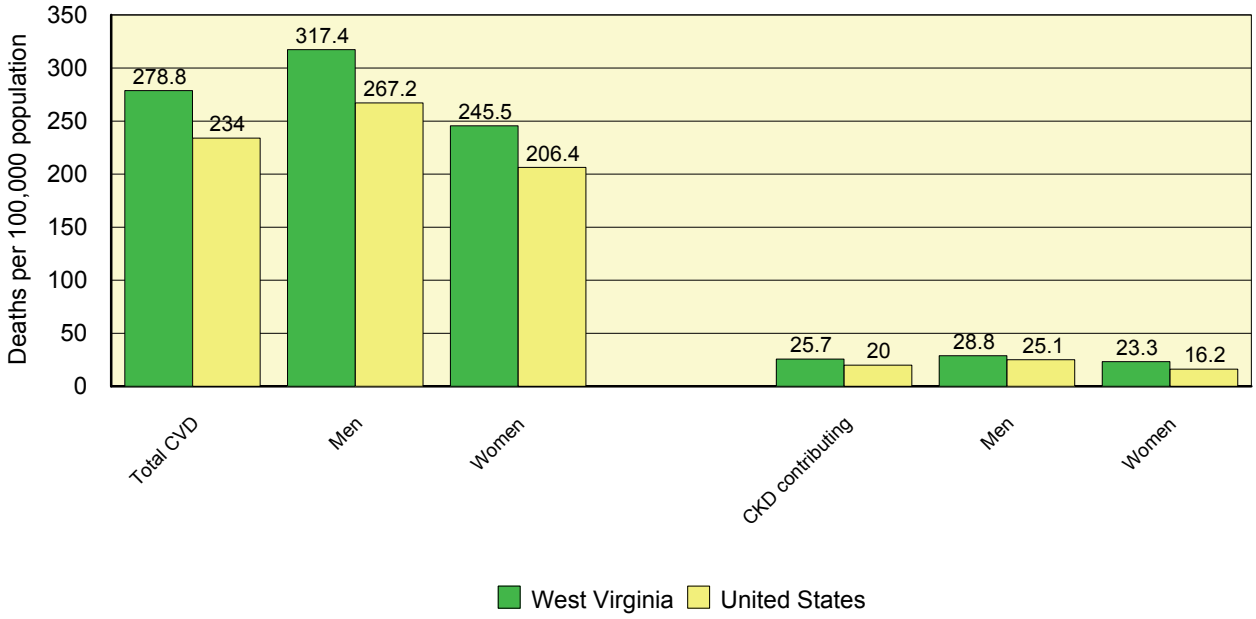
West Virginia also reported higher rates of CVD mortality than did the United States, overall and among both sexes. In both the state and the nation, approximately 9% of all CVD deaths had kidney disease listed as a contributing cause, with little difference between men and women. The state rates of CVD mortality and CVD mortality with kidney disease as a contributing factor were all higher than the corresponding national rates, as shown in Figure 27 on the following page.

Figure 26. Mortality rates for kidney disease as underlying cause of death and CVD as contributing cause of death, by gender
West Virginia and United States, 2002




NOTE: Rates are age adjusted to the 2000 U.S. standard million.

Figure 27. Mortality rates for CVD as underlying cause of death and kidney disease as contributing cause of death, by gender
West Virginia and United States, 2002




NOTE: Rates are age adjusted to the 2000 U.S. standard million.

# VII. Next Steps in Addressing CKD in West Virginia

- Create a Task Force to develop specific goals and strategies to improve the identification and management of people with CKD and to establish priorities to achieve these goals.

- Create a list of additional kidney-related resources, including links to Internet sites.

- Encourage and facilitate the development of partnerships between private and public organizations and agencies to achieve the goals of the Kidney Disease Task Force.

- Enlist support for CKD programs from federal agencies, e.g., National Institute of Diabetes, Digestive and Kidney Diseases and the CDC.

- Develop and maintain a roster of ESRD facilities, nephrologists, and transplant centers routinely providing services to West Virginia residents.

- Support and facilitate the use of estimated GFR in all hospitals and clinical laboratories that provide services in West Virginia.

- Improve the awareness of CKD among all health care practitioners, provider institutions, payers, and oversight/regulatory agencies.

- Encourage state-funded or coordinated health care clinics and insurance programs to: (a) adopt current guidelines for identifying and managing patients with CKD, including the use of evidence-based performance measures and (b) require the use of Medicare-approved ICD-9 codes for CKD.

- Support the creation of a CKD Registry in West Virginia

- Incorporate CKD education modules throughout community health centers, safety-net health care providers, and primary care providers.

- Establish priorities for research activities regarding CKD, including epidemiologic analyses, targeted interventions among high-risk populations, basic science and clinical investigation of hypertension and diabetes, and the effects of environmental factors on the development and progression of CKD.

- Enhance the work and effectiveness of kidney disease volunteer-based organizations, i.e., NKF affiliates responsible for providing services in West Virginia communities.

- Support the work of national professional kidney societies and organizations in improving professional and public education regarding CKD.

## APPENDIX A
## List of Acronyms

| | |
|---|---|
| ACE | Angiotensin-Converting Enzyme |
| ACR | Albumin-to-Creatinine Ratio |
| ARB | Angiotensin-Receptor Blockers |
| BMI | Body Mass Index |
| BRFSS | Behavioral Risk Factor Surveillance System |
| BUN | Blood Urea Nitrogen |
| CKD | Chronic Kidney Disease |
| CT | Computed Tomography scan |
| CVD | Cardiovascular Disease |
| DCCT | Diabetes Control and Complications Trial |
| EGHP | Employer Group Health Plans |
| ESRD | End Stage Renal Disease |
| GFR | Glomerular Filtration Rate |
| GN | Glomerulonephritis |
| HLA | Human Leukocyte Antigen |
| ICD-CM | International Classification of Diseases, Clinical Modification |
| K/DOQI | Kidney Disease Outcomes Quality Initiative |
| KEEP | Kidney Early Evaluation Program |
| LVH | Left Ventricular Hypertrophy |
| MARC | Mid-Atlantic Renal Coalition |
| MDRD | Modification of Diet in Renal Disease study |
| MRI | Magnetic Resonance Imaging scan |
| NCHS | National Center for Health Statistics |
| NHANES | National Health and Nutrition Examination Survey |
| NKF | National Kidney Foundation |
| OPTN | Organ Procurement and Transplantation Network |
| PKD | Polycystic Kidney Disease |
| RAS | Renal Artery Stenosis |
| UKPDS | United Kingdom Prospective Diabetes Study |
| USRDS | United States Renal Data System |
| WVHCA | West Virginia Health Care Authority |
| WVHSC | West Virginia Health Statistics Center |

# APPENDIX B
# Commonly Used Equations for Determining Level Of Kidney Function

**Creatinine Clearance (CCr) (mL/min) =**

[Urine creatinine (mg/dL) x volume (mL/24 h)] / serum creatinine (mg/mL) x time (min)

**Gault-Cockroft Creatinine Clearance (CCr) (mL/min) =**

[Weight (kd) x age (years)] / 72 x serum creatinine (mg/mL)
[for females, multiply by 0.85]

**MDRD estimated Glomerular Filtration Rate (eGFR) (ml/min/1.73m$^2$) =**

$170 \times SCr^{-0.999} \times age^{-0.176} \times BUN^{-01.70} \times albumin^{+0.318} \times 0.72$ (female) x 1.18 (AA)
[SCr in mg/dL; age in years; BUN in mg/dL; albumin in g/dL]

**eGFR (simplified) (mL/min/1.73m$^2$) =**

$186.3 \times SCr^{-0.154} \times age^{-0.203} \times 0.742$ (female) x 1.21 (AA)

**Schwartz eGFR (pediatrics) =**

0.55 x height (cm) / SCr (mg/dL)

**Counahan-Barratt eGFR (pediatrics) =**

0.43 x height (cm) / SCr (mg/dL)

# APPENDIX C
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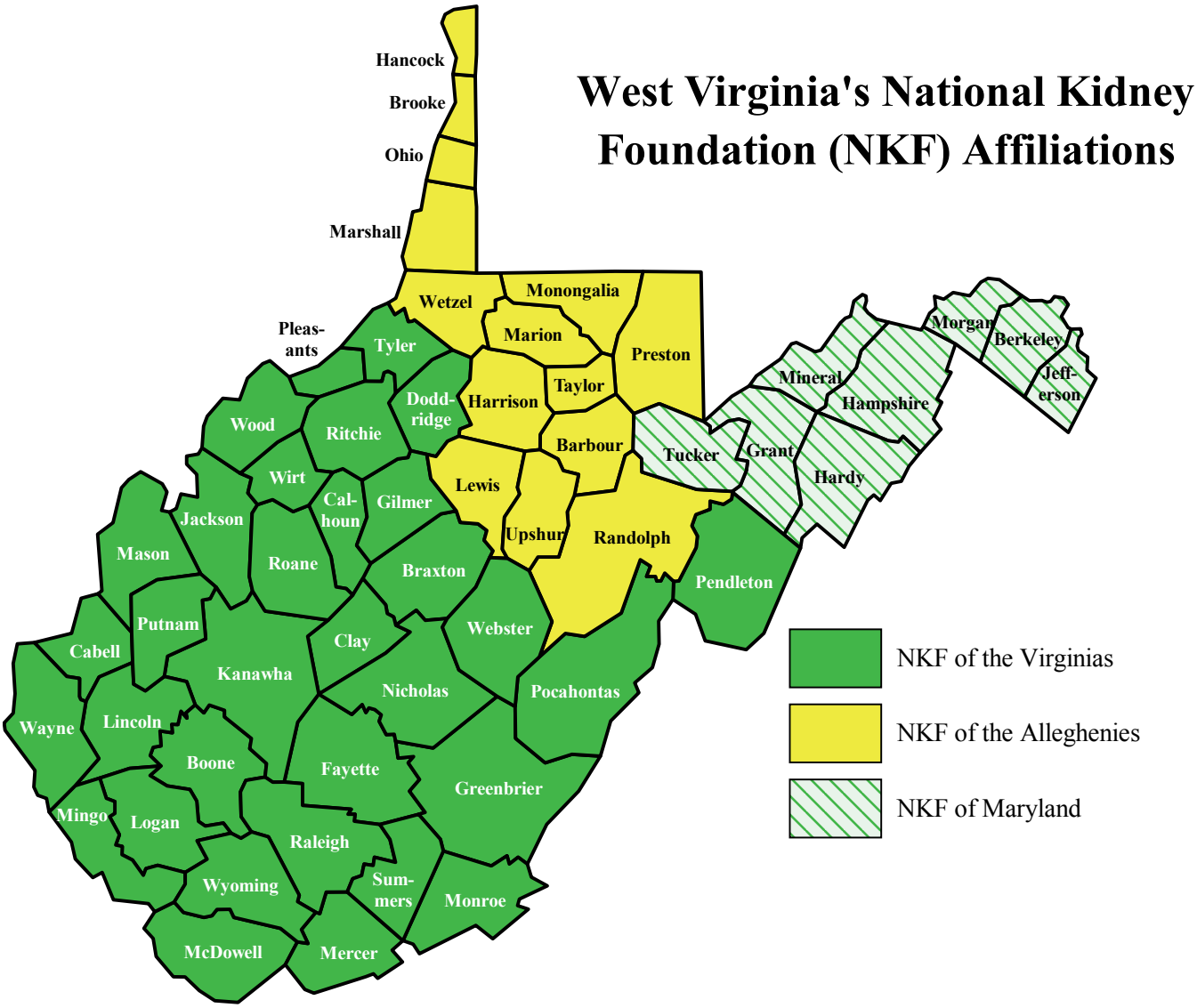
## APPENDIX D
## West Virginia's National Kidney Foundation Affiliations, 2006



## APPENDIX E
## Kidney Disease* Hospitalization Rates by County of Residence
## West Virginia, 2004

| County | Rate** | Rank | County | Rate** | Rank |
|---|---|---|---|---|---|
| Barbour | 123.4 | 24 | Monongalia | 91.0 | 35 |
| Berkeley | 39.2 | 49 | Monroe | 58.2 | 47 |
| Boone | 138.8 | 16 | Morgan | 31.0 | 53 |
| Braxton | 113.7 | 28 | Nicholas | 123.7 | 23 |
| Brooke | 82.3 | 39 | Ohio | 73.8 | 43 |
| Cabell | 157.8 | 9 | Pendleton | 35.5 | 50 |
| Calhoun | 126.8 | 22 | Pleasants | 134.4 | 18 |
| Clay | 134.3 | 19 | Pocahontas | 98.9 | 31 |
| Doddridge | 89.0 | 37 | Preston | 82.4 | 38 |
| Fayette | 200.2 | 3 | Putnam | 116.8 | 25 |
| Gilmer | 114.6 | 27 | Raleigh | 117.5 | 4 |
| Grant | 78.9 | 41 | Randolph | 97.6 | 33 |
| Greenbrier | 114.9 | 26 | Ritchie | 130.7 | 21 |
| Hampshire | 10.7 | 55 | Roane | 71.6 | 44 |
| Hancock | 97.8 | 32 | Summers | 106.5 | 29 |
| Hardy | 31.8 | 52 | Taylor | 94.4 | 34 |
| Harrison | 209.5 | 2 | Tucker | 56.8 | 48 |
| Jackson | 155.2 | 11 | Tyler | 63.0 | 46 |
| Jefferson | 34.0 | 51 | Upshur | 105.9 | 30 |
| Kanawha | 166.5 | 6 | Wayne | 74.6 | 42 |
| Lewis | 155.8 | 10 | Webster | 131.0 | 20 |
| Lincoln | 145.8 | 14 | Wetzel | 90.3 | 36 |
| Logan | 270.1 | 1 | Wirt | 137.1 | 17 |
| McDowell | 165.0 | 7 | Wood | 152.2 | 12 |
| Marion | 162.6 | 8 | Wyoming | 168.8 | 5 |
| Marshall | 66.8 | 45 | Total WV | 124.8 | |
| Mason | 81.3 | 40 | | | |
| Mercer | 150.3 | 13 | | | |
| Mineral | 29.8 | 54 | | | |
| Mingo | 143.1 | 15 | | | |

*ICD-9-CM codes 250.4, 403, 580-589, 753.4
**Rate per 10,000 population
Ranked highest (1) to lowest (55)
Source: WVHCA

## APPENDIX F
## Kidney Disease* Mortality Rates** by County of Residence
## West Virginia, 2004

| County | Rate** | Rank | County | Rate** | Rank |
|---|---|---|---|---|---|
| Barbour | 32.3 | 22 | Monongalia | 22.6 | 39 |
| Berkeley | 17.9 | 45 | Monroe | 51.6 | 6 |
| Boone | 31.1 | 23 | Morgan | 6.3 | 52 |
| Braxton | 40.1 | 17 | Nicholas | 45.7 | 9 |
| Brooke | 24.2 | 36 | Ohio | 22.0 | 41 |
| Cabell | 36.9 | 20 | Pendleton | 38.0 | 19 |
| Calhoun | 40.5 | 16 | Pleasants | 0.0 | |
| Clay | 9.6 | 51 | Pocahontas | 77.8 | 1 |
| Doddridge | 0.0 | | Preston | 26.8 | 31 |
| Fayette | 63.8 | 3 | Putnam | 27.9 | 30 |
| Gilmer | 14.3 | 49 | Raleigh | 26.5 | 32 |
| Grant | 52.0 | 5 | Randolph | 21.1 | 43 |
| Greenbrier | 57.3 | 4 | Ritchie | 47.7 | 8 |
| Hampshire | 0.0 | | Roane | 26.0 | 33 |
| Hancock | 41.3 | 14 | Summers | 29.0 | 29 |
| Hardy | 30.3 | 27 | Taylor | 43.2 | 10 |
| Harrison | 35.1 | 21 | Tucker | 42.6 | 12 |
| Jackson | 10.5 | 50 | Tyler | 42.7 | 11 |
| Jefferson | 16.8 | 47 | Upshur | 29.2 | 28 |
| Kanawha | 41.0 | 15 | Wayne | 42.3 | 13 |
| Lewis | 23.3 | 38 | Webster | 30.5 | 26 |
| Lincoln | 22.2 | 40 | Wetzel | 23.5 | 37 |
| Logan | 38.4 | 18 | Wirt | 17.1 | 46 |
| McDowell | 64.7 | 2 | Wood | 21.8 | 42 |
| Marion | 24.8 | 35 | Wyoming | 20.2 | 44 |
| Marshall | 14.4 | 48 | Total WV | 31.3 | |
| Mason | 30.8 | 24 | | | |
| Mercer | 30.6 | 25 | | | |
| Mineral | 25.8 | 34 | | | |
| Mingo | 51.1 | 7 | | | |

*ICD-10 codes N00-N07, N17-N19, N25-N27; E10.2, E11.2, E14.2; I12-I13
**Crude rates
Ranked highest (1) to lowest (52) (3 counties with no kidney mortality in 2004 not ranked)

Source: WVHSC

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