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The Increasing Incidence of End-Stage Renal Disease in Wisconsin from 1982-2003: An Analysis by Age, Race, and Primary Diagnosis

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ABSTRACT

Purpose: To examine the trends in the incidence of end-stage renal disease in Wisconsin from 1982 to 2003.

Methods: De-identified incidence data for this study were supplied by the Renal Network of the Upper Midwest (Region 11). We examined trends in the incidence of end-stage renal disease by age, race, gender, and primary diagnosis from 1982 to 2003.

Results: The incidence of end-stage renal disease increased more than 3-fold from 1982 to 2003. This increase was especially striking in persons with diabetes and hypertension, as well as among those aged ≥75 years. The increase in the incidence of end-stage renal disease was also apparent among all racial groups and both genders.

Conclusions: The continued increase in the incidence of end-stage renal disease in Wisconsin may result from a number of factors, such as an unintended consequence of better chronic disease management, which may predispose older individuals to end-stage renal disease. Resources aimed at decreasing the incidence of end-stage renal disease are needed to prevent unnecessary health care costs and negative health outcomes, including loss of life.

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INTRODUCTION

End-stage renal disease (ESRD) is defined by the US Renal Data System (USRDS) as "a condition in which an individual's kidney function is not adequate to support life."[1] Treatment is required to replace the work of the failed kidneys and prevent the build-up of harmful wastes in the body. ESRD is a costly disease that disproportionately affects people with diabetes and hypertension. According to the USRDS, there were over 400,000 people with ESRD and nearly 100,000 new cases of ESRD in the United States in 2002.[2] The ESRD benefit accounted for 6.7% of the Medicare budget in the same year—a total cost of $17 billion.[3] This cost is estimated to reach $28 billion by 2010.[4]

A previous paper by Russell et al demonstrated that from 1982 to 1997 in Wisconsin, the incidence of ESRD increased from 8.1 to 21.1 per 100,000 population.[5] One of the national *Healthy People 2010* objectives is to stop the increase in the incidence of ESRD. The goal set by *Healthy People 2010* is 21.7 new cases of ESRD per 100,000 population.[6] In this study, we examine trends in the incidence of ESRD in Wisconsin from 1982 to 2003. We also project the trend in the age-adjusted ESRD incidence rate to 2010 to assess the likelihood that the *Healthy People 2010* goal is attainable in Wisconsin.

METHODS

De-identified incidence data for ESRD were obtained from the Renal Network of the Upper Midwest (Network 11).[7] The Renal Network of the Upper Midwest is 1 of 18 renal networks in the United States. Incident cases are identified for all newly diagnosed ESRD patients who initiate ESRD therapy (dialysis or renal transplant) in a given year. All Wisconsin residents who receive treatment in Network 11 are included in the incidence rates for Wisconsin. Patients are not included in the incidence rates if they initiate

dialysis following the rejection of a kidney transplant or if they are an existing ESRD patient who recently moved into the Network 11 region.[7] The incidence data also do not reflect those individuals who do not initiate treatment.

The incidence of ESRD was calculated by dividing the number of new ESRD cases within a given year by the total population within the same calendar year. Population denominators were obtained from the Wide-Ranging Online Data for Epidemiologic Research (CDC-WONDER) database.[8] The population denominators for the Native American population were estimated by using regression techniques for years where this information was not available (1982-1989) by extrapolation from the 1990-2000 estimates. In addition, a regression line for the incidence of ESRD among Native Americans was fit to the data points from each year, as there is high variability in the rates from year to year due to low population counts within this group (R^2=0.7267). A regression line for the incidence of ESRD among African Americans and whites was also fit to the data points for comparability. All incidence rates were age-adjusted using the 2000 Wisconsin standard population and are expressed per 100,000 population. Confidence intervals of 95% were also calculated for the observed change in the incidence rate from 1982 to 2003.[9]

In order to measure the public health impact in the rise of new ESRD cases, we determined the excess number of ESRD cases that occurred in 2003, compared to 1982. The expected number of ESRD cases was calculated by multiplying the age-specific incidence rates in 1982 by the population in 2003. To determine the number of excess cases, the expected number of ESRD cases was subtracted from the observed number of cases in 2003.

Human subject approval was granted for this study by the University of Wisconsin-Madison Institutional Review Board.

RESULTS

The incidence of ESRD increased more than 3-fold from 1982 to 2003 (Figure 1). In 1982, the age-adjusted incidence rate for ESRD was 8.6 per 100,000 population. This age-adjusted incidence rate increased to 27.9 per 100,000 population by 2003. The *Healthy People 2000* goal for Wisconsin was 13.4 new cases per 100,000 population; however, the actual incidence of ESRD in Wisconsin in 2000 was 25.2 cases per 100,000 population. The *Healthy People 2010* target for objective 4.1 (reduce the rate of new cases of end-stage renal disease) is 21.7 cases per 100,000 popula-

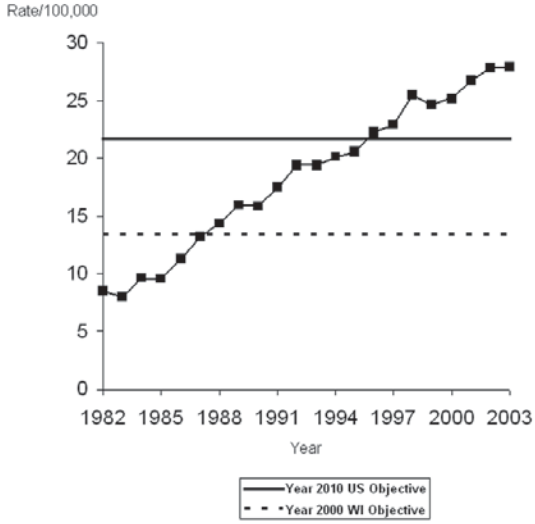

Figure 1. Trends in age-adjusted end-stage renal disease incidence rate in Wisconsin, 1982-2003.

Table 1. Age-Adjusted Incidence Trends of Treated End-Stage Renal Disease in Wisconsin per 100,000 Population by Sex, Age, and Race, 1982-2003

	1982 Rate (#)	2003 Rate (#)	Rate Difference	Rate Ratio*
Total	8.6 (398)	27.9 (1586)	19.3	3.2†
Age				
<45	4.8 (157)	5.7 (199)	0.9	1.2
45-55	10.7 (47)	23.1 (200)	12.4	2.2†
55-64	22.0 (95)	56.8 (285)	34.8	2.6†
65-74	20.5 (70)	114.5 (413)	94.0	5.6†
75+	11.7 (29)	133.5 (489)	121.8	11.4†
Sex				
Male	10.4 (227)	31.6 (781)	21.2	3.0†
Female	7.2 (172)	26.4 (805)	19.2	3.7†
Race				
White‡	7.9 (352)	24.0 (1276)	16.1	3.0†
<45	4.5 (137)	4.3 (131)	-0.2	0.95
45-54	8.8 (37)	17.2 (125)	8.4	2.0†
55-64	20.7 (87)	45.8 (217)	25.1	2.2†
65-74	18.8 (63)	103.2 (345)	84.4	5.5†
75+	11.5 (28)	125.4 (449)	113.9	10.9†
African-American‡	30.5 (39)	118.1 (241)	87.6	3.9†
<45	11.0 (18)	19.4 (<5)	8.4	1.8
45-54	63.9 (9)	173.5 (63)	109.6	2.7†
55-64	53.1 (5)	274.6 (52)	221.5	5.2†
65-74	116.2 (6)	332.0 (41)	215.8	2.9†
75+	37.7 (<5)	563.7 (32)	526.0	14.2†
Native American‡§	28.1 (6)	99.8 (27)	71.7	3.6†

* Defined as the ratio of the 1982 to 2003 incidence rates
†Statistically significant rate ratio (P<0.05)
‡ All ages
§Native American rates by age group were not reported because of the low numbers in each age category

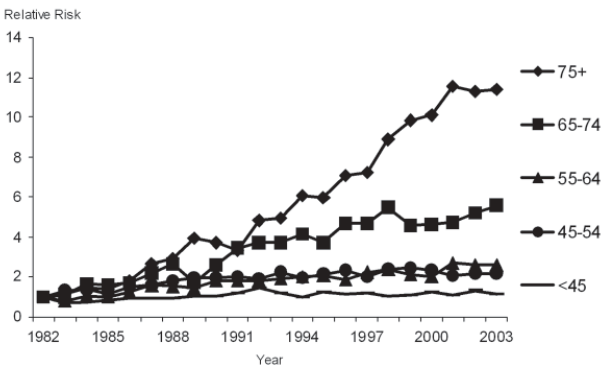

Figure 2. Wisconsin age-specific trends in end-stage renal disease incidence by relative risk, relative to 1982: 1982-2003.

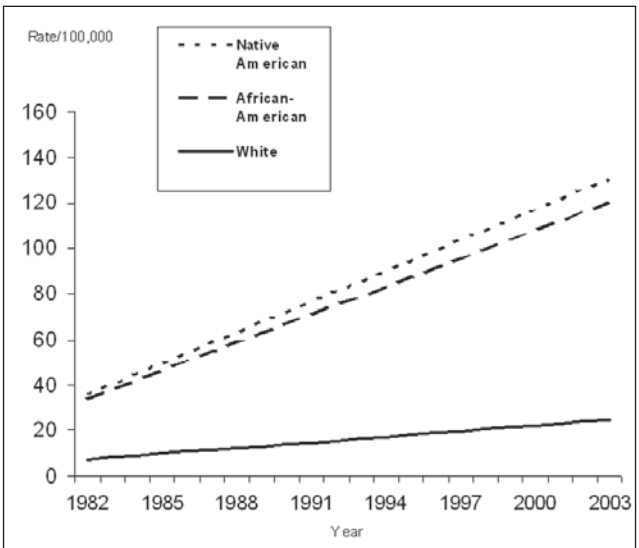

Figure 3. Wisconsin age-adjusted end-stage renal disease incidence by race (regression lines): 1982-2003.

tion (Figure 1). In order to attain this 2010 objective, the incidence of ESRD in Wisconsin would not only have to stop increasing, but would have to decrease by 22%.

If the incidence rate in 1982 had continued through 2003, there would be an estimated 487 persons initiating treatment for ESRD in 2003. However, in 2003 there were actually 1586 persons who initiated treatment for ESRD, or 1099 excess cases of ESRD.

Age

The 2003 incidence of ESRD in Wisconsin was highest in those ≥75 years old. This is in contrast to the incidence rates in 1982, which peaked among those aged 55-64, and the incidence rates in 1997, which peaked among those aged 65-74.[5] Between 1982 and 2003, there was an increase in the incidence rate among all age groups. This increase was statistically significant ($P<0.05$) for all age groups except for individuals <45 years of age (Table 1). The incidence rate among those aged 65-74 increased nearly 6-fold from 1982 to 2003, and the incidence rate among those aged ≥75 years increased more than 11-fold (Figure 2) during this same time period.

Gender

End-stage renal disease incidence rates were greater among men than women in 1982, 1997,[5] and 2003. Incidence rates for ESRD from 1982 to 2003 were 3 times greater in men and nearly 4 times greater in women (Table 1).

Race

In Wisconsin, the ESRD incidence among African Americans was nearly 5 times that of whites in 2003. This represents an increase in the disparity between whites and African Americans from 1982 and 1997,[5] where the incidence was approximately 4 times higher among African Americans than whites. The disparity in the incidence rates between whites and Native Americans also increased from 1982 to 2003. The incidence of ESRD increased among whites, African Americans, and Native Americans from 1982 to 2003; however, this increase was greatest among African Americans (Table 1).

For both whites and African Americans, the largest increase in the incidence of ESRD occurred among those 75 years and older. The increase in the rate for whites and African Americans in this age group increased nearly 11-fold and over 14-fold respectively from 1982 to 2003 (Table 1). The increase in the incidence of ESRD among Native Americans by age group did not show significant increases from 1982 to 2003 due to the low number of cases and relatively small population estimates within this racial group.

Primary Diagnosis

Diabetes and hypertension were the leading attributed causes of ESRD in 2003. Together, diabetes and hypertension were the primary diagnosis for nearly two thirds of all cases of ESRD. In 1982, diabetes and hypertension accounted for only one half of all cases of ESRD. From 1982 to 2003, the increase in the primary diagnosis of diabetes and hypertension was 4.7 and 5.8, respectively (Table 2). From 1982 to 1997, the increase in the primary diagnosis of diabetes and hypertension was 4.3 and 3.8, respectively.[5] The leading attributed cause of ESRD in 1982 was diabetes, followed by glomerulonephritis (inflammation of the internal kidney structures). However, in 2003, glomerulonephritis as the primary diagnosis for

ESRD accounted for less than 9% of all ESRD cases. There was also an over 4-fold increase in ESRD incidence among patients with illnesses in the "other" category. ("Other" includes the following diseases: systemic lupus erythematosus, Wegener's, scleroderma, Alport's, other congenital diseases, anti-GBM, chronic pyelonephritus, obstructive nephropathy, interstitial nephritis, myeloma, gout, malignanicies, amyloidosis, other metabolic diseases, focal glomerulosclerosis, and other.) The incidence of ESRD due to chronic kidney disease, other urologic, and unknown causes of ESRD did not significantly increase from 1982 to 2003 (Table 2).

Primary Diagnosis by Racial Group

The incidence of ESRD due to diabetes and hypertension within racial groups from 1982 to 2003 was also examined. The incidence of ESRD from diabetes increased among all racial groups. The increase was highest among Native Americans, where the incidence of ESRD with diabetes listed as the primary diagnosis increased 5.5-fold from 1982 to 2003. When hypertension was listed as the primary diagnosis, the incidence of ESRD increased among whites and African Americans from 1982 to 2003. This increase was most pronounced among whites (Table 3).

Table 2. Trends in the Incidence of ESRD per 100,000 Population by Primary Diagnosis: 1982-2003

Primary Diagnosis	Rate (No.) 1982	Rate (No.) 2003	Rate Difference	Rate Ratio*
Diabetes	2.4 (113)	11.2 (626)	8.8	4.7†
Hypertension	1.4 (66)	8.1 (452)	6.7	5.8†
Glomerulonephritis	2.0 (93)	2.5 (140)	0.5	1.25
Chronic Kidney Disease	0.6 (27)	0.9 (50)	0.3	1.5
Other‡	0.9 (42)	3.9 (218)	3.0	4.3†
Other Urologic	0.4 (19)	0.8 (42)	0.4	2.0
Unknown Cause	0.8(39)	1.0 (58)	0.2	1.25

*Defined as the ratio of the 2003 to 1982 incidence rates
†Statistically significant rate ratio (P<0.05)
‡"Other" includes the following diseases: systemic lupus erythematosus, Wegener's, scleroderma, Alport's, other congenital diseases, anti-GBM, chronic pyelonephritus, obstructive nephropathy, interstitial nephritis, myeloma, gout, malignancies, amyloidosis, other metabolic diseases, focal glomerulosclerosis, and other.

Table 3. Trends in the Incidence of ESRD in Wisconsin per 100,000 Population by the Primary Diagnosis of Diabetes and Hypertension by Racial Group: 1982-2003

	1982 Rate (#)	2003 Rate (#)	Rate Difference	Rate Ratio*
Diabetes				
White	2.2 (99)	9.7 (483)	7.5	4.4†
African American	6.1 (12)	29.4 (102)	23.2	4.8†
Native American	8.5 (3)	46.3 (23)	37.8	5.5†
Hypertension‡				
White	1.2 (54)	12.7 (630)	11.5	10.5†
African American	6.1 (12)	20.2 (70)	14.0	3.3†

*Defined as the ratio of the 2003 to 1982 incidence rates.
†Statistically significant rate ratio (P<0.05).
‡A Native American rate for hypertension was not reported because of low numbers.

DISCUSSION

The incidence of ESRD has continued to increase steadily in Wisconsin over the past 22 years. This increase is apparent in all age categories, but is greatest among those aged ≥75 years. This is consistent with national trends, which also demonstrate a sizable increase in the incidence of ESRD.[3] The increase is apparent among whites, African Americans, and Native Americans. Although the incidence rate of ESRD increased among all 3 examined racial groups, the increase was more pronounced among African Americans and Native Americans. Nationally, the ESRD incidence rate is 4 times higher in both African Americans and Native Americans compared to whites.[6] These trends have increased the disparity in ESRD by race in Wisconsin.

The disparity in the incidence of ESRD is not entirely explained by an increase in diabetes or hypertension among African Americans or Native Americans. The number of new cases of ESRD due to hypertension increased over 3-fold among African Americans from 1982 to 2003, but this increase was over 10-fold among whites. Nationally, African Americans and Native Americans have a higher prevalence of diabetes compared to whites. In 2003, over three fourths of new ESRD cases among Native Americans and nearly half of all new cases among African Americans were attributed to diabetes. However, the increase in diabetes as the primary diagnosis of ESRD from 1982 to 2003 also increased 4.4-fold among whites.

Clearly, the increase in the racial disparity of new ESRD cases in Wisconsin cannot be completely explained by a disproportionate increase in the primary risk factors for this disease. Sociodemographic factors such as education, household income, and insurance status may help explain some of the excess risk of ESRD, as delayed diagnosis and access to optimal interventions contribute to health disparities.[10] In addition, behavioral factors such as health knowledge, dietary and lifestyle habits, and patient-physician interactions need to be

explored to assess their contribution to disparities in ESRD.[11]

Several reasons have been proposed for the increase in the incidence of ESRD. First, this increase may be the result of a decrease in competing causes of death.[12] For example, it is well-documented that there has been a decline in the death rate due to cardiovascular disease.[13,14] Individuals at risk for cardiovascular disease often have risk factors (such as diabetes and hypertension) that would also predispose them to ESRD. Therefore, preventing deaths related to cardiovascular disease, as well as other comorbidities, may increase the number of individuals at high risk for ESRD. This hypothesis is in agreement with the increase in the number of ESRD cases in Wisconsin, particularly among those aged ≥75 years (Figure 2).

Second, the increase in the incidence of ESRD may be the result of an increase in risk factors associated with ESRD, particularly type 2 diabetes.[15] Diabetes-related ESRD accounted for nearly 40% of all new cases of ESRD in Wisconsin in 2003. Nationally, diabetes accounted for 44% of all new cases of ESRD in 2002.[2] Both the prevalence and the incidence of diabetes are increasing in Wisconsin and nationally.[6,16,17] In order to decrease the incidence of ESRD, it may be beneficial to target resources at state-based Diabetes Prevention and Control Programs. Additionally, risk factors for diabetes and hypertension, such as overweight and obesity, and lack of physical activity should also be targeted in order to more effectively minimize the underlying causes of ESRD.

Additional possible explanations for the increase in the incidence of ESRD include increased referral of patients to receive treatment, increased utilization of treatment, earlier initiation of treatment, or simply an increase in renal disease.[5,12] Clearly, there are many possible explanations for the increase in the incidence of ESRD. What is known is that it is affecting individuals of all ages and racial groups. In the Medicare population, the cost for dialysis is approximately $53,000 per patient per year receiving care.[3] Unless individuals refuse treatment for ESRD, it is not ethical to deny renal replacement therapy to patients, as this treatment is necessary to sustain life. Resources aimed at decreasing the incidence of ESRD are needed to prevent unnecessary health care costs, and, more importantly, negative health outcomes including the loss of life attributed to ESRD.

CONCLUSION

The incidence of ESRD in Wisconsin has steadily increased from 1982 to 2003. This increase has affected individuals of all ages and racial groups. The largest burden of the increase in ESRD is among persons ≥75 years, as well as individuals with diabetes and hypertension. The increase in the incidence of ESRD may be the result of a number of different factors. Improvements in disease management for other chronic illnesses may predispose a greater proportion of the population to ESRD. Since the life-expectancy of the population is growing, it is not surprising that ESRD is more prevalent in an older population. Additionally, the increase may be attributed to the increasing diabetes incidence, which is the leading underlying cause of ESRD. More research is needed in order to identify the primary cause for the steady increase in the incidence in ESRD. Furthermore, resources should be effectively targeted in order to decrease the monetary burden, increase in morbidity, and loss of life from ESRD.

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