RACIAL DISPARITIES IN ACCESS TO RENAL TRANSPLANTATION:

Clinically Appropriate or Due to Underuse or Overuse?

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Abstract

Background—Despite abundant evidence of racial disparities in the use of surgical procedures, it is uncertain whether these disparities reflect racial differences in clinical appropriateness or overuse or under-use of care.

Methods—We performed a literature review and used an expert panel to develop criteria for determining the appropriateness of renal transplantation for patients with end-stage renal disease. Using data from five states and the District of Columbia on patients who had started to undergo dialysis in 1996 or 1997, we selected a random sample of 1518 patients (age range, 18 to 54 years), stratified according to race and sex. We classified the appropriateness of patients as candidates for transplantation and analyzed data on rates of referral to a transplantation center for evaluation, placement on a waiting list, and receipt of a transplant according to race.

Results—Black patients were less likely than white patients to be rated as appropriate candidates for transplantation according to appropriateness criteria based on expert opinion (71 blacks [9.0 percent] vs. 152 whites [20.9 percent]) and were more likely to have had incomplete evaluations

(368 [46.5 percent] vs. 282 [38.8 percent], P<0.001 for the overall chi-square). Among patients considered to be appropriate candidates for transplantation, blacks were less likely than whites to be referred for evaluation, according to the chart review (90.1 percent vs. 98.0 percent, P=0.008), to be placed on a waiting list (71.0 percent vs. 86.7 percent, P=0.007), or to undergo transplantation (16.9 percent vs. 52.0 percent, P<0.001). Among patients classified as inappropriate candidates, whites were more likely than blacks to be referred for evaluation (57.8 percent vs. 38.4 percent), to be placed on a waiting list (30.9 percent vs. 17.4 percent), and to undergo transplantation (10.3 percent vs. 2.2 percent, P<0.001 for all three comparisons).

Conclusions—Racial disparities in rates of renal transplantation stem from differences in clinical characteristics that affect appropriateness as well as from underuse of transplantation among blacks and overuse among whites. Reducing racial disparities will require efforts to distinguish their specific causes and the development of interventions tailored to address them.

Numerous studies performed over the past decade have documented racial disparities in the use of effective surgical procedures,[1–9] both discretionary and non-discretionary,[10] and there is no evidence that these differences have diminished substantially. The failure to improve black patients' relative access to surgical procedures may reflect skepticism on the part of clinicians and policymakers about the interpretation of inequities. Indeed, rates of use alone are not valid indicators of the quality of care. The critical questions are whether blacks are less likely than whites to undergo necessary surgical procedures, and whether whites are more likely than blacks to undergo surgical procedures when nonsurgical management is indicated.

Renal transplantation is an excellent model for exploring these questions. Almost all candidates for the procedure can be reliably identified,[11] and renal transplantation is associated with a longer life expectancy,[12,13] a better quality of life,[12,14,15] and lower costs than is long-term dialysis.[12,16] Thus, racial differences in access to this procedure[14,15,17–26] have potentially critical implications for the quality and cost of care.

We developed and validated criteria to determine the appropriateness of renal transplantation for patients with end-stage renal disease. We then examined racial differences in rates of referral, placement on a waiting list, and transplantation according to whether patients were appropriate or inappropriate candidates for this intervention.

METHODS

Criteria for Assessing Appropriateness

We based our criteria for appropriateness on the presence or absence of factors constituting absolute or relative contraindications to transplantation. To develop the criteria, we adapted methods used by RAND[27,28] and described by the Institute of Medicine.[29]

First, we reviewed the literature, including published guidelines[16] and a summary of existing scientific evidence on contraindications to renal transplantation and the required preliminary evaluation. Second, we asked physician consultants to refine the information and identify potential criteria for appropriateness. Third, the criteria were further refined and ratings were developed according to the judgments of a panel of expert nephrologists and transplantation

surgeons from academic and nonacademic centers throughout the United States. The ratings for candidates for transplantation were as follows: appropriate (no contraindications), inappropriate (one or more absolute contraindications or three or more relative contraindications), or equivocal (one or two relative contraindications). The panel also specified the requisite elements of an evaluation for transplantation, such as the use of either coronary angiography or adequate noninvasive testing in patients with coronary artery disease. Patients who had not undergone the necessary diagnostic tests were classified as having had an incomplete workup unless they had known coexisting disorders that made them inappropriate candidates. The complete list of clinical criteria for transplantation is provided on the *Journal*'s Web site at http://www.nejm.org and has been deposited with the National Auxiliary Publications Service.[*]

Survey of Physicians

To validate our criteria, we surveyed by mail the nephrologists who provided care for the patients in the study. They were asked to rate 18 coexisting disorders that were included in our criteria as "critical" if the disorder alone would render transplantation inappropriate; "significant" if the disorder, combined with several similarly rated disorders, would often render transplantation inappropriate; or "incidental" if the disorder, alone or in conjunction with other disorders, would generally not render transplantation inappropriate.

Study Sample

We obtained data on patients with end-stage renal disease from four regional end-stage renal disease networks that are funded by the Health Care Financing Administration (HCFA) and that serve geographically diverse areas (Alabama; southern California; Michigan; and the District of Columbia, Maryland, and Virginia). The study was approved by HCFA as a special study that the networks would perform to fulfill their mandate to monitor and improve the quality of care for patients with end-stage renal disease. As a result, we were permitted to use clinical data maintained by the dialysis facilities and abstracted by the networks. The institutional review boards of Harvard Medical School and the Harvard School of Public Health approved a chart review, with the data to be reported anonymously, and a survey of the patients, in which we obtained oral informed consent.

Each network identified adults between the ages of 18 and 54 years in whom maintenance dialysis had been initiated between May 1996 and June 1997 (in Alabama, the period was extended through September 1997). Children were excluded because special criteria for appropriateness would have been required for them, and adults older than 54 years of age were excluded because they are more likely to have coexisting illnesses that would preclude transplantation. To obtain a target sample of 1500 patients, we selected a stratified random sample of black women, black men, white women, and white men in each region, totaling 2223 patients. We excluded 415 patients (77 black women, 93 white women, 119 black men, and 126 white men). The reasons for exclusion were as follows: the patient had died within nine months after the initiation of dialysis (182 patients); had regained kidney

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function or had discontinued dialysis for another reason (74); had received a kidney transplant or had begun dialysis before 1996 (69); had moved out of the region within nine months after the start of dialysis (40); refused to participate (14); was incarcerated (13); received dialysis at more than three facilities, was lost to follow-up, or received dialysis at an unknown or decertified facility (13); was not entitled to Medicare coverage because of immigration status (5); did not have end-stage renal disease, had a date of birth that fell outside the specified age range, or was not black or white (3); or had medical records that were unavailable (2).

The networks obtained medical records for the remaining 1808 eligible patients until they reached their respective quotas (300 for Alabama, 300 for southern California, 400 for Michigan, and 500 for the District of Columbia, Maryland, and Virginia). The 290 patients whose charts were not obtained did not differ significantly from the 1518 patients in the study cohort in terms of age, sex, race, primary cause of end-stage renal disease, or type of dialysis (P>0.20 for all comparisons), but they were less likely to live in urban areas (84 percent vs. 91 percent, P=0.002). Of the 705 patients who were excluded or whose charts were not abstracted, 23 percent (18 percent of the blacks and 29 percent of the whites) were placed on a waiting list for a transplant, as compared with 39 percent of the study sample (28 percent of the blacks and 51 percent of the whites), and 9 percent (4 percent of the blacks and 14 percent of the whites) received a transplant, as compared with 15 percent of the sample (6 percent of the blacks and 25 percent of the whites).

Collection of Clinical Data

In order to obtain the data required to determine the appropriateness of transplantation, nurses in each network and at the Harvard School of Public Health abstracted information from the medical records maintained by the patients' primary dialysis center for the first nine months of care after the initiation of dialysis. If these records were incomplete, we also obtained medical records from the patients' nephrologists, other specialists, and their respective transplantation centers. The nurses received two days of training in chart abstraction. A supervising nurse at the Harvard School of Public Health reviewed the data abstracted by network personnel for completeness and clinical logic.

Survey of Patients

We contacted 1169 (76.6 percent) of the 1518 patients in the study sample (77.4 percent of the black patients and 77.4 percent of the white patients) by telephone approximately 10 months after they had started dialysis and asked them whether they had been referred to a transplantation center for evaluation. We also asked questions about socioeconomic characteristics (marital status, automobile ownership, insurance status, education, and income), health status (on a scale from 0 to 100, with 0 representing the poorest health and 100 the best health a person of a given age can have),[30] and preferences (whether or not they wanted a renal transplant and how certain they were of this preference). The 1169 surveyed patients were part of a cohort of 1392 patients described previously.[31] The rate of response was higher than 95 percent for all variables except income (response rate, 90 percent).

Indicators of Access to Transplantation

We reviewed medical charts for evidence that patients had been referred to a transplantation center for evaluation within nine months after the initiation of dialysis and used the survey data to determine patients' perceptions about whether they had been referred for evaluation for transplantation. We obtained data from the United Network for Organ Sharing (UNOS) to identify patients who had been placed on the waiting list for a cadaveric transplant or who had received a cadaveric transplant within 18 months after the initiation of dialysis. The networks identified for us patients who had received a transplant from a living donor within 18 months.

Statistical Analysis

To assess the degree of concordance between the ratings of coexisting disorders provided by the nephrologists who responded to our survey and our criteria for appropriateness for transplantation, we determined the percentage of respondents who rated as critical the coexisting conditions considered to be absolute contraindications according to our criteria and the percentage who rated as either critical or significant the coexisting conditions considered to be relative contraindications.

We compared the demographic and clinical characteristics of the patients in an analysis stratified according to sex as well as race, because prior studies have suggested that there are sex differences in access to renal transplantation.[8,19,22,25] We also examined the distribution of appropriateness ratings (appropriate, equivocal, incomplete workup, and inappropriate) according to race and sex. We used the t-test for continuous variables and the chi-square test for categorical variables.

For each category of appropriateness, we calculated the proportion of patients, stratified according to race and sex, who had access to renal transplantation as indicated by a referral to a transplantation center for evaluation within 9 months after the initiation of dialysis, according to the chart review; a referral for evaluation within approximately 10 months, according to the survey of patients; placement on the UNOS waiting list within 18 months; or receipt of a transplant within 18 months. To assess underuse, we analyzed access among patients classified as appropriate candidates. To assess overuse, we examined access among patients classified as inappropriate candidates. We used the chi-square test to determine the statistical significance of differences between groups. When calculating the proportion of patients who were placed on a waiting list, we excluded those who had received a transplant from a living donor, since these patients may not have been placed on the UNOS waiting list for a cadaveric transplant.

We used two logistic-regression models to examine the effect of covariates on appropriateness ratings. One model included race and sex as predictors; the other included race, sex, education, income, and region. We also used multivariate logistic-regression models to derive adjusted rates for our four indicators of access to transplantation, controlling for age, region, primary cause of renal failure, distance from the patient's residence to a transplantation center, education, income, health status, and the patient's preferences with respect to transplantation.[32] Because these models included survey data,

the results are based on the 1169 patients who were surveyed. We used similar models to assess access to care for the entire cohort of 1518 patients, with adjustment for the covariates obtained from the chart review (appropriateness rating, age, region, and primary cause of renal failure). The results of these two analyses were similar, and results from the second set of models are therefore not presented. Finally, to assess the possibility that reduced access to transplantation for blacks reflects the fact that they receive care in facilities with generally low rates of referral for transplantation, we compared racial differences with respect to the indicators of access, controlling for appropriateness ratings, between dialysis centers with higher overall rates of referral (above the median) and those with lower overall rates of referral, as assessed through a chart review. All reported P values are based on two-tailed tests of statistical significance.

RESULTS

Characteristics of the Study Population

The percentages of black patients and white patients, by design, were similar among the regions; the mean age of blacks and whites was also similar (Table 1). However, there were a number of differences in social, demographic, and clinical characteristics according to race.

Validation of the Appropriateness Criteria

We asked 298 of the 496 nephrologists (60 percent) who cared for one or more of the study patients about 12 absolute contraindications and 6 relative contraindications to transplantation as defined by the expert panel. More than 70 percent of the physicians surveyed rated nearly all of the absolute contraindications as critical. The only exceptions were systemic lupus erythematosus with major complications (rated as critical by 64 percent of the respondents), a body-mass index (the weight in kilograms divided by the square of the height in meters) higher than 35 (rated as critical by 42 percent of the respondents), and gastrointestinal bleeding within the previous six months (rated as critical by 22 percent of the respondents). More than 80 percent of the respondents rated as either critical or significant coexisting conditions that were incorporated into our algorithm as relative contraindications. The only exception was a body-mass index of 30 to 35 (rated as critical or significant by 60 percent of the respondents).

Appropriateness for Renal Transplantation

At the time of the chart review, approximately nine months after the initiation of dialysis, blacks were less likely than whites to be considered appropriate candidates for transplantation (9.0 percent vs. 20.9 percent) and were more likely to have had an incomplete workup (46.5 percent vs. 38.8 percent, P<0.001 for the overall chi-square) (Table 2). When we adjusted the appropriateness ratings shown in Table 2 for income, education, and region, the ratings were essentially unchanged. In the adjusted analysis, for example, 9.8 percent of blacks were considered to be appropriate candidates, as compared with 21.4 percent of whites. The most common reasons that patients were considered to be inappropriate candidates were a body-mass index of 35 or higher, the presence of an active infection, and the presence of severe extrarenal, non-cardiac conditions.

Access to Renal Transplantation According to Appropriateness

Table 3 shows the proportion of patients in each category of appropriateness who had access to transplantation as indicated by the study end points representing the clinical pathway to transplantation. The proportion of patients with these end points varied according to the category of appropriateness. For example, 81.4 percent of patients considered to be appropriate candidates were placed on a waiting list. The corresponding proportions for patients in the equivocal, incomplete-workup, and inappropriate categories were 75.4 percent, 34.7 percent, and 23.4 percent.

Forty-eight of 792 blacks (6.1 percent) and 183 of 726 whites (25.2 percent) underwent transplantation. A total of 3.2 percent of the blacks and 12.9 percent of the whites received a transplant from a living donor.

Underuse of Renal Transplantation—The findings related to the underuse of transplantation are shown in the first part of Table 3. Almost all white women (97.2 percent) and white men (98.8 percent) rated as appropriate candidates were referred for evaluation, according to the chart review, as compared with 94.1 percent of black women and 86.5 percent of black men (P=0.43 for the comparison between black women and white women, P=0.005 for the comparison between black men and white men, and P=0.008 for the overall comparison between blacks and whites). The overall differences in access to renal transplantation between black patients and white patients and the relative magnitude of underuse of transplantation among blacks were larger for the three other indicators of access to renal transplantation. However, there was no significant difference between the proportions of black women and white women who were placed on a waiting list.

Overuse of Renal Transplantation—The last section of Table 3 shows the results with respect to overuse of transplantation. Among patients who were considered to be inappropriate candidates for transplantation, white patients were more likely than black patients to have been referred for evaluation and placed on a waiting list, and a larger proportion of white patients in this category received a transplant (10.3 percent vs. 2.2 percent, P<0.001). Of the 231 patients who received a transplant, only 33 (14.3 percent) were considered to be inappropriate candidates; 7 were black, and 26 were white. In this group, 4 blacks (57.1 percent) and 13 whites (50.0 percent) received transplants from living donors.

Adjusted Analyses of Access to Transplantation

Table 4 shows the results of our multivariate analyses of data related to underuse and overuse of transplantation. Among patients who were considered to be appropriate candidates for transplantation, blacks were less likely than whites to have been referred for evaluation, according to the chart review (P=0.09) and the survey of patients (P=0.007), and were less likely to have received a transplant (P<0.001). The results were similar with respect to overuse (Table 4). Among patients who were considered to be inappropriate candidates for transplantation, whites were more likely than blacks to have been referred for evaluation and placed on a waiting list and to have received a transplant. The results of all the multivariate analyses, including those for patients whose appropriateness for

transplantation was rated as equivocal or whose workup was incomplete, are available over the Inter-net at http://www.nejm.org and have been deposited with the National Auxiliary Publications Service.[*]

A number of covariates were significantly associated with overuse and underuse. In the analysis of underuse, a higher level of education was a predictor of referral for evaluation according to the patient survey (P=0.02) and of transplantation (P=0.05); younger age was a predictor of referral according to the patient survey (P=0.02); the patient's preferences were a predictor of referral according to the survey (P= 0.01) and of placement on a waiting list (P=0.05); residence in Alabama was a predictor of referral according to the survey (P=0.03); and residence in southern California was a predictor of transplantation (P=0.04). In the analysis of overuse, a higher level of education was associated with placement on a waiting list (P=0.02); the patient's preferences were associated with referral for evaluation according to the chart review and the survey and were associated with placement on a waiting list (P<0.001 for all three comparisons); younger age was associated with all four indicators of access (P<0.001 for each comparison); residence in Michigan or Alabama was a predictor of referral according to the survey (P=0.005 and P=0.02, respectively); and a shorter distance from the patient's residence to the nearest transplantation facility was associated with referral according to the chart review and the survey (P=0.05 for both comparisons).

Stratification According to the Referral Rate at the Dialysis Center

We adjusted for ratings of appropriateness and analyzed racial differences in access to transplantation according to whether the dialysis facilities had high or low rates of referral to transplantation centers. There were significant racial differences for all four indicators of access. For example, at high-referral dialysis facilities, 84.1 percent of blacks and 91.2 percent of whites were referred for evaluation according to the chart review (P=0.003); 46.2 percent of blacks and 63.1 percent of whites were placed on a waiting list (P<0.001). At low-referral facilities, 38.3 percent of blacks and 58.2 percent of whites were referred for evaluation according to the chart review (P<0.001); 20.4 percent of blacks and 42.4 percent of whites were placed on a waiting list (P<0.001).

DISCUSSION

Our results suggest that lower rates of renal transplantation among black patients in part reflect racial differences in clinical characteristics that make fewer blacks clinically appropriate candidates for transplantation. However, blacks also appear to receive fewer transplants, regardless of the clinical indications, a pattern that results in the relative underuse of transplantation among blacks who are appropriate candidates for transplantation and the relative overuse among whites who are inappropriate candidates. Some might argue that racial disparities mainly reflect underlying clinical differences according to race, and others might counter that racial disparities reflect race-based barriers to the receipt of appropriate care. We found evidence that the situation is more complex than either of these explanations would suggest.

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Our data support the findings of Alexander and Sehgal,[25] who documented a sequence of potential barriers along the clinical pathway to renal transplantation. Intervention at any single point is unlikely to eliminate racial disparities. Our finding that blacks were less likely to be appropriate candidates for transplantation than were whites suggests that even if blacks and whites had equal access to renal transplantation, their rates of referral, placement on a waiting list, and transplantation might not be the same.

The proportion of patients in our study — over 40 percent — with incomplete medical workups nine months after the initiation of dialysis was striking. More than 30 percent of these patients were placed on the UNOS waiting list within 18 months, suggesting either that their workups were completed after the 9-month observation period or that physicians were willing to place them on the waiting list and perform transplantation without all the elements considered necessary by our panel. Approximately 40 percent of the patients with incomplete workups were not formally referred for evaluation at a transplantation center. Patients' preferences or clinical data not recorded in the medical charts could have accounted for a portion of this failure to refer patients, although we assume that some of the patients who were not referred were simply lost in the health care system because of fragmented and uncoordinated care.

The degree of concordance between the surveyed nephrologists' ratings of coexisting conditions and the criteria we used to define appropriateness was similar to that reported previously in a comparable study of coronary angiography.[33] The observed practice patterns provide additional validation of our criteria. The proportion of patients who were put on the waiting list or who received a transplant was much higher in the group considered to be appropriate candidates than in the group considered to be inappropriate candidates. Among patients who received transplants, 14 percent were considered to be inappropriate candidates, a proportion similar to that in studies of the overuse of other major surgical procedures.[34–36]

The racial differences in rates of transplantation may be related in part to immunologic matching criteria that result in more frequent donor matches for whites than for blacks.[37] Since 1996, when UNOS started using less strict immunologic matching criteria, increased numbers of blacks have received transplants.[38] In our cohort (as well as nationally[39]) a greater proportion of whites than blacks received a transplant from a living donor, although this difference accounted for only a portion of the racial disparities identified in our study.

Our study has several limitations. First, in our analysis of underuse, the number of patients who were considered to be appropriate candidates for transplantation was small. Unstudied factors may skew the results with such small numbers. Second, appropriateness ratings vary among expert panels,[40] and the absolute numbers of persons in categories of overuse and underuse would be likely to vary according to the particular panel. However, we would not expect this variation to affect the racial differences in ratings. Third, our study population was restricted to persons between the ages of 18 and 54 years. Whereas a substantial proportion of patients receiving dialysis for the first time are 55 or older, there is also a substantial decline in rates of transplantation among older patients.[11] Finally, we studied a condition for which almost all patients in the United States have insurance coverage and are

in close contact with the medical care system — two factors that would be expected to reduce racial disparities in care.

In summary, the explanation of racial disparities in the use of renal transplantation in patients with end-stage renal disease is complex. The disparities result in part from racial differences in the clinical appropriateness of patients as candidates for transplantation. Although the subgroups in our sample were relatively small, there was evidence of both underuse of transplantation among blacks and overuse among whites. Reducing racial disparities requires efforts to distinguish the different causes and to tailor interventions in order to address them.

Acknowledgments

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APPENDIX. CRITERIA FOR RATINGS OF APPROPRIATENESS FOR RENAL TRANSPLANTATION

Ratings

Appropriate: no critical or relative contraindications

Equivocal: one or two relative contraindications

Inappropriate: one or more critical contraindications or three or more relative contraindications that, taken together, are judged as critical

Incomplete workup: one or more partial or incomplete clinical evaluations necessary for pretransplantation workup

Critical Contraindications

Active malignant condition

Active infection documented, with treatment in the past month

Active tuberculosis documented by chest film and culture

Human immunodeficiency virus infection

Life expectancy of less than 2½ years

Severe functional impairment requiring level II skilled nursing

Body-mass index greater than 35

Active systemic lupus erythematosus with major clinical signs

Positive for hepatitis B surface antigen, with chronic active hepatitis on biopsy

Positive for both hepatitis B surface antigen and hepatitis B e antigen

Positive for both hepatitis B virus and hepatitis C virus

Positive for hepatitis C virus, with chronic active hepatitis on biopsy

Severe cardiac disease (e.g., left main coronary artery or three major vessels with more than 70 percent occlusion, left ventricular ejection fraction of less than 25 percent, class III or IV angina despite maximal management, New York Heart Association class III or IV congestive heart failure despite maximal management, high risk for cardiac ischemia or atherosclerotic disease according to the results of noninvasive testing, acute myocardial infarction within the past six months, or symptomatic valvular insufficiency)

Cerebral vascular accident within the past six months

Transient ischemic attack within the past six months and untreated vascular disease

Advanced atherosclerotic peripheral vascular disease, uncorrected abdominal aortic aneurysm, or major amputation due to vascular disease

Severe chronic obstructive pulmonary disease, severe pulmonary fibrosis, or severe restrictive pulmonary disease (documented forced expiratory volume in one second, less than 25 percent of the predicted value; documented partial pressure of arterial oxygen, less than 60 mm Hg at rest; exercise-induced oxygen desaturation, less than 90 percent by pulse oximetry) or four or more respiratory infections or episodes of pneumonia in the past 12 months

Chronic active hepatitis or cirrhosis

Major gastrointestinal bleeding in the past six months

Acute diverticulitis in the past six months without definitive surgical resection

Acute pancreatitis in the past six months

Acute cholecystitis and diabetes mellitus without cholecystectomy

Major psychiatric disorder (or psychosis, confusional state, or dementia) that is unstable despite maximal management

Psychiatric disorder exacerbated by steroid medications

Active substance abuse or positive result of drug screening; patient refused drug counseling or it was unsuccessful

Sickle cell disease with more than four episodes of sickle-cell crisis in the past 12 months

Oxalosis (not responsive to pyridoxine) and combined liver–kidney transplantation not planned

Anti–glomerular basement membrane disease with elevated levels of circulating anti–glomerular basement membrane antibodies

Relative Contraindications

Body-mass index of 30 to 35

Moderate coronary artery disease (e.g., untreated 50 to 70 percent occlusion of one or two vessels, but not the left main coronary artery, and a left ventricular ejection fraction of 25 to 35 percent)

Moderate chronic obstructive pulmonary disease (documented forced expiratory volume in one second, 25 to 50 percent; documented partial pressure of oxygen, 60 to 70 mm Hg at rest) or restrictive lung disease or sarcoidosis with exercise-induced desaturation of at least 90 percent

Systemic lupus erythematosus without major signs for six months or less

Active tuberculosis and antituberculin treatment for six months or less

Chronic pancreatitis quiescent for 12 months or less

Acute diverticulitis more than 6 months but less than 12 months ago, without definitive surgical resection

Hepatitis B or C without chronic active hepatitis on biopsy

Cholelithiasis and diabetes mellitus without cholecystectomy

Acute cholecystitis within the past 12 months without cholecystectomy

Membranoproliferative glomerular nephritis as the cause of end-stage renal disease

Incomplete Workup

History of or multiple risk factors for coronary artery disease, cardiac symptoms (e.g., angina), or congestive heart failure and no cardiac evaluation in past 12 months

Hypertension and history of coronary artery disease without adequate cardiac evaluation (e.g., radionuclide imaging or echocardiography with analysis of systolic function and thallium or dipyridamole–thallium exercise-tolerance testing or coronary angiography)

Diabetes mellitus for more than 25 years or in a patient older than 45 years without adequate cardiac evaluation (e.g., radionuclide imaging or echo-cardiography with analysis of systolic function and thallium or dipyrida-mole–thallium exercise-tolerance testing or coronary angiography)

Report of abnormal or ischemic result on noninvasive cardiac testing and cardiac catheterization not performed

Elevated values on liver-function testing (more than twice the upper limit of the normal range) for more than two months and liver biopsy not performed

Positive for hepatitis B virus and liver-function tests or liver biopsy not performed

Positive for hepatitis C virus and liver biopsy not performed

Test for human immunodeficiency virus not performed

Active substance abuse or positive result of drug screening and inadequate or incomplete counseling

History of substance abuse and drug screening not performed

Chronic obstructive pulmonary disease and pulmonary-function testing not performed and partial pressure of arterial oxygen not determined or oximetry not performed

Table 1

Demographic and Clinical Characteristics of the Study Cohort According to Race and Sex.[*]

Characteristic	Black Women (N=415)	White Women (N=373)	P Value	Black Men (N=377)	White Men (N=353)	P Value
Region (%)						
Alabama	19.3	20.1		20.7	21.3	
Michigan	27.7	26.5		25.2	25.8	
Southern California	19.0	21.2		19.9	21.8	
Maryland, Virginia, and the District of Columbia	34.0	32.2		34.2	31.2	
Mean age (yr)	42.3	42.4	0.004	41.8	41.7	0.004
Education (%)[†]			<0.001			<0.001
College graduate	8.7	15.0		12.2	19.8	
High-school graduate	64.2	67.0		62.6	64.6	
Neither	27.1	18.0		25.2	15.7	
Annual income (%)[†]			<0.001			<0.001
$60,000	4.7	17.7		9.4	22.8	
$40,000–59,999	10.3	16.7		9.4	15.7	
$20,000–39,999	20.9	26.9		27.6	25.0	
$12,000–19,999	19.6	17.0		19.9	16.8	
<$12,000	30.8	11.2		21.7	14.5	
Not available	13.7	10.5		11.9	5.2	
Married (%)[†]	31.2	61.2	<0.001	46.2	56.7	0.01
Employed (%)[†]	13.1	25.2	<0.001	19.6	32.1	<0.001
Automobile owner (%)[†]	63.2	91.5	<0.001	84.3	92.5	0.003
Private health insurance (%)[†][‡]	37.1	66.3	<0.001	39.5	61.9	<0.001
Immediate family member with kidney disease (%)[†]	21.8	22.3		23.0	17.5	
Primary cause of renal disease (%)			0.001			0.001
Diabetes mellitus	41.9	45.8		29.2	47.0	
Hypertension	30.8	8.9		39.3	9.1	
Glomerulonephritis	4.8	4.8		6.1	5.7	
Lupus erythematosus	6.3	6.7		1.3	1.4	

Characteristic	Black Women (N=415)	White Women (N=373)	P Value	Black Men (N=377)	White Men (N=353)	P Value
Other	16.1	33.8		24.1	36.8	
Type of dialysis facility (%)			0.02			
For profit	67.2	65.3		68.4	69.4	
Not for profit	26.0	31.7		23.7	24.4	
Public	6.8	3.0		8.0	6.2	
Score for overall health during dialysis[†§]	65.3	58.9	<0.001	65.6	60.6	0.008
Score for effect of kidney disease on daily life[†¶]	36.0	34.0		37.3	35.7	
Coexisting illness (%)[†]						
Coronary heart disease	13.0	20.1	0.007	14.6	24.4	<0.001
Congestive heart failure	10.1	13.7		11.7	13.0	
Peripheral vascular disease	7.0	8.3		5.0	11.3	0.002
Chronic lung disease	3.1	3.2		3.7	3.4	
Cancer	3.1	4.3		2.9	2.6	
Mean distance from residence to nearest transplantation facility (km)	14.5	24.8	<0.001	14.3	23.4	<0.001

*
Pearson's chi-square test or Student's t-test was used to compare black women with white women and black men with white men. Where no P values are given, differences were not significant.

[†]
Results are based on a survey of 321 black women (77.4 percent), 294 white women (78.8 percent), 286 black men (75.9 percent), and 268 white men (75.9 percent). These 1169 patients represented 77.0 percent of the entire sample.

[‡]
Data are for patients with or without Medicare or Medicaid insurance.

[§]
Scores for health status ranged from 0 (poor) to 100 (excellent).

[¶]
Scores ranged from 0 to 100, with higher scores indicating fewer adverse effects of kidney disease on daily life.

Table 2

Appropriateness for Transplantation According to Race and Sex.[*]

Appropriateness of Transplantation	Black Women (N=415)	White Women (N=373)	Black Men (N=377)	White Men (N=353)	All Blacks (N=792)	All Whites (N=726)	All Patients (N=1518)
				number of patients (percent)			
Appropriate	34 (8.2)	72 (19.3)	37 (9.8)	80 (22.7)	71 (9.0)	152 (20.9)	223 (14.7)
Equivocal	27 (6.5)	21 (5.6)	14 (3.7)	19 (5.4)	41 (5.2)	40 (5.5)	81 (5.3)
Incomplete workup	188 (45.3)	139 (37.3)	180 (47.7)	143 (40.5)	368 (46.5)	282 (38.8)	650 (42.8)
Inappropriate	166 (40.0)	141 (37.8)	146 (38.7)	111 (31.4)	312 (39.4)	252 (34.7)	564 (37.2)

[*]The results of unadjusted analyses are shown. P<0.001 for all comparisons between black patients and white patients, including those between black women and white women and those between black men and white men, by chi-square analysis.

Table 3

Indicators of Access to Transplantation According to Appropriateness and to Race and Sex, before Adjustment.

Appropriateness Category and Indicator of Access*	Black Women	White Women	P Value	Black Men	White Men	P Value	All Blacks	All Whites	P Value	All Patients
Appropriate										
No.	34	72		37	80		71	152		223
Referred (%)										
Chart review	94.1	97.2	0.43	86.5	98.8	0.005	90.1	98.0	0.008	95.5
Survey†	81.5	98.3	0.005	76.7	98.4	<0.001	79.0	98.4	<0.001	92.1
Placed on waiting list (%)	81.8	82.5	0.93	61.1	90.3	<0.001	71.0	86.7	0.007	81.4
Received transplant (%)	17.7	44.4	0.007	16.2	58.8	<0.001	16.9	52.0	<0.001	40.8
Equivocal										
No.	27	21		14	19		41	40		81
Referred (%)										
Chart review	92.6	100.0	0.20	92.9	100.0	0.24	92.7	100.0	0.08	96.3
Survey†	87.5	94.4	0.45	91.7	100.0	0.24	88.9	97.1	0.19	92.9
Placed on waiting list (%)	73.1	70.6	0.86	61.5	100.0	0.01	69.2	83.3	0.18	75.4
Received transplant (%)	22.2	52.4	0.03	21.4	73.7	0.003	22.0	62.5	<0.001	42.0
Incomplete workup										
No.	188	139		180	143		368	282		650
Referred (%)										
Chart review	49.5	70.1	<0.001	56.5	76.1	<0.001	52.9	73.1	<0.001	61.7
Survey†	52.2	76.9	<0.001	59.2	79.0	<0.001	55.7	77.9	<0.001	65.3
Placed on waiting list (%)	18.7	48.9	<0.001	32.0	46.3	0.01	25.2	47.6	<0.001	34.7
Received transplant (%)	3.7	18.0	<0.001	7.2	19.6	<0.001	5.4	18.8	<0.001	11.2
Inappropriate										
No.	166	141		146	111		312	252		564
Referred (%)										
Chart review	40.0	53.9	0.02	36.6	62.7	<0.001	38.4	57.8	<0.001	47.1
Survey†	32.6	46.8	0.02	36.6	58.3	0.003	34.3	51.8	<0.001	42.3
Placed on waiting list (%)	15.8	29.2	0.005	19.3	33.0	0.01	17.4	30.9	<0.001	23.4
Received transplant (%)	1.2	9.9	<0.001	3.4	10.8	0.02	2.2	10.3	<0.001	5.9

*
Data on referral of patients for evaluation are for the first 9 months (chart review) or approximately 10 months (survey) after the start of dialysis. Data on waiting-list placement and transplantation are for the first 18 months after the start of dialysis.

†
Data were obtained from the survey of 1169 patients.

Table 4

Adjusted Indicators of Access to Transplantation According to Appropriateness and to Race and Sex.[*]

Appropriateness Category and Indicator of Access[†]	Black Women	White Women	P Value	Black Men	White Men	P Value	All Blacks	All Whites	P Value
Appropriate									
No.	27	58		30	63		57	121	
Referred (%)									
Chart review	93.1	96.1	0.60	90.9	96.0	0.57	92.1	96.1	0.09
Survey	87.7	92.3	0.05	88.9	92.3	0.38	88.4	92.3	0.007
Placed on waiting list (%)	85.6	82.4	0.49	68.7	85.9	0.12	77.7	84.6	0.34
Received transplant (%)	18.8	41.0	0.14	16.4	62.2	0.002	17.2	52.2	<0.001
Equivocal									
No.	24	18		12	16		36	34	
Referred (%)									
Chart review	92.6	100.0		92.9	100.0		92.7	100.0	
Survey	87.5	94.4		91.7	100.0		88.9	97.1	
Placed on waiting list (%)	75.3	73.3	0.94	75.2	76.3	0.42	75.9	76.5	0.52
Received transplant (%)	25.8	54.0	0.12	24.7	68.8	0.15	26.0	60.4	0.02
Incomplete workup									
No.	138	108		143	105		281	213	
Referred (%)									
Chart review	47.8	75.7	<0.001	57.9	77.2	0.012	52.9	76.5	<0.001
Survey	51.0	75.6	0.001	60.3	76.1	0.05	55.7	75.9	<0.001
Placed on waiting list (%)	21.7	61.6	<0.001	39.3	50.3	0.37	30.0	55.6	<0.001
Received transplant (%)	7.3	21.9	0.006	8.6	21.3	0.002	7.9	21.6	0.002
Inappropriate									
No.	132	110		101	84		233	194	
Referred (%)									
Chart review	43.1	58.8	0.21	36.4	67.7	0.013	40.1	62.8	0.005
Survey	36.1	50.4	0.37	33.2	53.6	0.16	34.8	51.8	0.07
Placed on waiting list (%)	19.1	34.7	0.07	20.9	37.8	0.20	19.9	36.0	0.02
Received transplant (%)	1.5	23.5	0.01	6.0	22.8	0.04	3.1	19.8	0.001

*
Logistic-regression models included, in addition to race and sex, the following covariates: age, region, primary cause of renal failure, education, income, overall health status, patients' preferences (wanting or not wanting a transplant and being certain or uncertain about wanting it), and distance from residence to nearest transplantation facility. Results are based on the 1169 patients for whom survey data were available.

†
Data on referral for evaluation are for the first 9 months (chart review) or approximately 10 months (survey) after the start of dialysis. Data on waiting-list placement and transplantation are for the first 18 months after the start of dialysis.