Management of Patients with Chronic Renal Insufficiency in the Northeastern United States

ANNAMARIA T. KAUSZ,* SAMINA S. KHAN,* REKHA ABICHANDANI,* WAQAR H. KAZMI,* GREGORIO T. OBRADOR,* ROBIN RUTHAZER,† and BRIAN J. G. PEREIRA*

Divisions of *Nephrology and † Clinical Care Research, Department of Medicine, New England Medical Center, Boston, Massachusetts.

Abstract. Comorbid conditions that develop during chronic renal insufficiency (CRI) contribute to the high morbidity and mortality among patients with end-stage renal disease (ESRD). Thus, appropriate management during CRI may lead to improved ESRD outcomes. A retrospective cohort study was performed to describe the management of patients with CRI. A total of 602 patients with CRI (creatinine ≥1.5 mg/dl for women and ≥2.0 mg/dl for men) were seen between October 1994 and September 1998 at five nephrology outpatient clinics in the Boston area. The mean (SD) age of the patients was 63 (15.5) yr, and 53% were male. At the first nephrology visit, mean (SD) serum creatinine was 3.2 (1.6) mg/dl, and mean (SD) predicted GFR was 22.3 (8.9) ml/min per 1.73 m². Laboratory tests for iron levels were performed in only 18% of patients, serum parathyroid hormone levels were obtained in only 15%, lipid studies were obtained in fewer than half, and among patients with diabetes, only 28% had a glycosylated hemoglobin level measured. A hematocrit <30% was present in 38%, and abnormal calcium-phosphorus metabolism was noted in 55%. Only 59% of patients who had hematocrit <30% received recombinant human erythropoietin. Among patients who received recombinant human erythropoietin, only 47% received iron. Angiotensin-converting enzyme inhibitor use was recorded for only 65% of patients with diabetes (49% of patients overall). Among patients who were known to have progressed to ESRD, only 41% had permanent access placed before initiation of dialysis. There seems to be room for improvement in the management of patients with CRI, which could result in a slower rate of progression of CRI and reduced severity of comorbid conditions.

The prevalence of end-stage renal disease (ESRD) in the United States increased by 7% per year between 1992 and 1996 and was 306,967 at the end of 1997 (1). The morbidity and mortality among patients with ESRD is high, and the care of these patients consumes a significant proportion of health care resources (2,3). Clinical and economic outcomes among patients with ESRD are influenced by a number of factors, such as age, gender, race, malnutrition, and nonrenal comorbid conditions (4–6). However, comorbid conditions begin to develop early during the course of chronic renal insufficiency (CRI). It was estimated recently that 2.5 million individuals in the United States have serum creatinine levels ≥1.7 mg/dl and 0.8 million have serum creatinine levels ≥2.0 mg/dl (7). Timely and optimal care during CRI could modify the severity of comorbid conditions and the high mortality among patients with ESRD. Furthermore, improved and timely care during CRI possibly may improve the quality of life of patients with renal insufficiency, reduce the incidence of ESRD, and reduce the cost of ESRD care (8,9). Thus, optimization of care during CRI could be the key to improved ESRD outcomes.

Although formal guidelines for care of the patient with CRI do not exist, few would argue that optimal care should involve early diagnosis of renal insufficiency and use of interventions to delay its progression, prevention or attenuation of the expected clinical and biochemical abnormalities of renal dysfunction, modification of comorbid conditions, adequate preparation for ESRD therapy, and timely initiation of dialysis. However, there is limited information on the patterns of testing of CRI patients for prevalence of complications of CRI and nonrenal comorbidity or the practice of the above-mentioned interventions. Hence, we performed a historical prospective cohort study to investigate the current status of care during CRI in the Greater Boston area.

Materials and Methods

Patients

The sample of patients with CRI was derived from patients who received outpatient care in the nephrology clinics at New England Medical Center, St. Elizabeth’s Medical Center, or three nephrology private practices, all in the Greater Boston area. Patients were included if they were older than 18 yr. Patients were defined as having CRI if the serum creatinine was ≥1.5 mg/dl for women and ≥2.0 mg/dl for men on at least two occasions. Office records were reviewed for all patients who attended outpatient nephrology clinics between October 1994 and September 1998. Identification of patients with CRI in the New England Medical Center nephrology clinic was done by reviewing the serum creatinine levels and diagnoses of all patients identified as having a nephrology clinic visit by query of the computerized utilization database. At the St.
Elizabeth’s Medical Center and private nephrology practices, patients with CRI were identified by manual review of the clinic records. Patients who were followed at more than one of these sites were assigned to the site at which a majority of the care was provided.

The time of entry into the study was the first date that criteria for CRI were met for patients whose first visit to the clinic occurred after October 1, 1994. For patients with criteria for CRI who were followed earlier, October 1, 1994, was considered to be the date of entry into the study. Follow-up information was obtained until the start of dialysis, transplantation, transfer to another facility, end date of the study (September 1998), or death, whichever occurred earliest. Among patients who were followed in clinic before October 1, 1994, the first date of diagnosis of CRI and visit to the nephrologist were recorded if available.

**Data Sources**

Data were abstracted by three nephrologist investigators (R.A., W.K., and S.K.) and entered directly into an electronic database designed for this study. The data were obtained by review of the hospital and clinic charts of all sites; the computerized laboratory databases of St. Elizabeth’s Medical Center and area nephrologists when available; and the computerized database with information on hospitalizations, laboratory results, and other hospital-based care of New England Medical Center.

**Data Collection**

The total number of patients seen in the outpatient clinics during the time frame of the study was recorded for all sites. Among patients who were identified as having CRI, data were collected at baseline and each subsequent visit during the time frame of the study (between October 1, 1994, and September 30, 1998). Baseline data included demographic (age, gender, and race), socioeconomic (type of insurance, occupation, and education), and clinical (cause of CRI, year of diagnosis, and comorbid conditions/index of disease severity [IDS] score) information. The IDS score was obtained by assigning one of four disease severity levels (from 0 = not present to 3 = uncontrolled condition) to 20 different disease domains, and the global IDS score was the maximum score assigned to any of the domains (10). Data obtained at each visit during the study period included laboratory test results, as recorded in the chart or available in the laboratory database, such as blood urea nitrogen, serum creatinine, albumin, bicarbonate, sodium, potassium, calcium, phosphate, alkaline phosphates, intact parathyroid hormone (PTH), glucose, glycosylated hemoglobin (HbA1C), cholesterol, low-density lipoprotein, triglyceride, hematocrit (HCT), and hemoglobin and clinical data such as systolic and diastolic BP and information on the medications/interventions, such as recombinant human erythropoietin (rHuEPO), calcitriol, phosphate binder, angiotensin-converting enzyme inhibitors (ACE-I), any other antihypertensive, and lipid-lowering agent. In addition, dates of first discussions regarding need for renal replacement therapy (RRT), modality selection, access placement, and dialysis initiation were recorded. Duration and causes of hospitalization were recorded when identified.

**Definitions and Equations**

It was decided a priori that ACE-I use was going to be considered as prescribed for delaying the progression of renal insufficiency. Hypertension (HTN) was defined as systolic BP >140 mmHg and/or diastolic BP >90 mmHg on more than two occasions or non–ACE-I antihypertensive medication use. Hypercholesterolemia was defined as serum cholesterol >200 mg/dl and/or lipid-lowering agent use. Hypoalbuminemia was defined as two or more serum albumin levels <3.5 mg/dl. The method used to assay serum albumin was not known at most of the sites. Anemia was defined as a HCT <30%, before rHuEPO, if any use recorded. Abnormal calcium-phosphorus metabolism was defined as a PTH level >100 pg/dl and/or a serum phosphorus level >4.5 mg/dl or use of calcitriol and/or phosphate binder. Acidosis was defined as serum bicarbonate level <20 mmol/L. Medication use was included in the definitions for hypercholesterolemia and abnormal calcium-phosphorus metabolism, because the assumption was made that if therapy was being used, at some time the patient must have had a sufficiently abnormal laboratory value to justify initiation of therapy. GFR in ml/min per 1.73 m² was predicted using the equation derived from the results of the Modification of Diet in Renal Disease Study (11): 170 × [serum creatinine (mg/dl)]⁻⁰·₉⁹⁹ × [age (yr)]⁻⁰·₁₇₆ × [0.762 if female] × [1.18 if black] × [blood urea nitrogen (mg/dl)]⁻⁰·₃₁₈.

**Data Categorization**

Age was categorized as 18 to 40, 41 to 64, 65 to 74, and >75 yr. Patients were assigned to one of the following racial groups: white, black, Asian, Hispanic, or other. The causes of CRI were classified as diabetes, HTN, glomerulonephritis/intersitial nephritis/polycystic kidney disease, or other. The principal type of insurance for each patient was recorded as health maintenance organization (HMO), private (fee-for-service), Medicare, Medicaid, or none. For patients with Medicare and either HMO or private insurance, type of insurance was assigned to the latter.

**Statistical Analyses**

The proportion of patients with CRI who received outpatient follow-up in the nephrology clinics during the time frame of the study was determined. Descriptive statistics of demographic and clinical characteristics at baseline were obtained. The serum creatinine and predicted GFR at the first nephrology visit was determined overall and by patient characteristic. Descriptive statistics and frequency distributions of continuous and categorical variables, as appropriate, were obtained. The prevalence of anemia, hypoalbuminemia, HTN, hypercholesterolemia, and abnormal calcium-phosphorus metabolism, noted at any time during the study, was calculated. The prevalence of each of these conditions also was calculated for each age, gender, race, cause of CRI, and insurance category. The serum creatinine and predicted GFR were determined at the initial diagnosis of the above-mentioned conditions, first recorded institution of medications/interventions as listed above, discussion relating to need for dialysis, access placement, and at last visit before initiation of dialysis. When there was no laboratory value corresponding to the date of diagnosis of the condition, the peak creatinine closest to the time point within ±60 d was used for the determination.

**Results**

A total of 4016 patients were followed in the nephrology practices during the study period. A total of 682 (17%) met the study criteria for CRI; of these, 602 (88%) had data that could be evaluated. The mean length of follow-up among patients with two or more visits during the study period was 428 d (median 273 d). Selected details of baseline demographic, clinical, and laboratory characteristics are presented in Table 1. Overall, 28% of the patients had diabetes and 25% had HTN as cause of CRI. However, 87% had HTN as a documented condition. The majority of patients had an IDS score of 2 (85%), and only 11% of patients had an IDS score of 3. The majority of the
patients had HMO insurance (64%), 13% of patients had private insurance, 17% had Medicare, 4% had Medicaid, and only 2% of patients had no insurance (details not shown).

Timing of First Visit to Nephrology

The first nephrology visit occurred, on average, when the serum creatinine was 3.1 mg/dl and the GFR was 22.2 ml/min per 1.73 m². The distributions of serum creatinine levels and predicted GFR at the first nephrology visit are presented in Figure 1. Renal function at first nephrology visit varied slightly by patient demographic and clinical characteristic, but the differences were not statistically significant (data not shown).

Screening for Selected Conditions Associated with CRI

The prevalence of screening for conditions that are commonly associated with CRI varied widely (Table 2). Most patients had HCT, serum calcium, and phosphorus levels obtained at some time during the study. However, only 18% of patients had iron studies, although 38% of patients had HCT <30% at some time during the study. Only 15% had a serum PTH level documented at any time during follow-up. Fewer than half of the patients had lipid levels recorded. Among patients with the diagnosis of diabetes, only 28% had a HbA1C level either recorded in the chart or available in the laboratory database.

Prevalence of Selected Conditions Associated with CRI

Details of the prevalence of selected conditions overall and by demographic characteristics and cause of CRI are presented in Table 3. A total of 38% of the patients had or developed severe anemia (HCT <30%) at some time during the study. Patients with diabetes as cause of CRI had a higher prevalence of anemia, compared with patients who had other causes of CRI (P < 0.05). Patients with private insurance had a lower prevalence of anemia (26%), whereas patients with Medicaid had a higher prevalence of anemia (63%), compared with patients with no (43%) or other (38 to 45%) types of insurance (P < 0.05). Fifty-five percent of patients met criteria for abnormal calcium-phosphorus metabolism. Patients of white and Asian race had a lower prevalence of abnormal calcium-phosphorus metabolism than patients of black and other races. Forty-two percent of patients had hypercholesterolemia at some time during the study, and there were no significant differences by patient characteristics (details not shown). Hypoalbuminemia was found among 22% of the patients. Patients with diabetes as cause of renal disease had the highest prevalence of hypoalbuminemia (33%), and patients with other causes of CRI had the lowest prevalence (7%; P < 0.05). The prevalence of HTN was 97% (details not shown). Nineteen percent of the patients met criteria for acidosis at some time during the study, with a higher prevalence of acidosis among female patients (24%, compared with 15% among male patients; P < 0.05).

Management of CRI

ACE-I use was recorded for only 49% of patients overall. However, among patients with diabetes either as a comorbid
condition or as the cause of renal disease, ACE-I use was recorded for 65%, compared with 39% among patients without diabetes \((P < 0.001)\). Eighty percent of the patients were on a non–ACE-I antihypertensive medications. However, 65% of patients overall had two or more BP recordings \(>140/90\) mmHg. Among patients with diabetes with a \(\text{HbA1C}\) level recorded, 55% had at least one level \(>7.5\%\) (details not shown).

**Treatment of Selected Conditions among Affected Patients with CRI**

rHuEPO therapy at some time during the study was recorded for 20% of patients overall, and 18% of patients received iron. Among patients who received rHuEPO at some time during the study, 47% received iron, compared with 10% among patients who never received rHuEPO. Among patients who developed severe anemia (HCT <30%) at some time during the study, 59% received rHuEPO. There were no significant differences in the prevalence of use of rHuEPO by patient characteristics. However, a higher proportion of anemic patients with private, HMO, or Medicare insurance tended to receive rHuEPO (57 to 70%), compared with patients with Medicaid (42%) or no insurance (33%). Eighteen percent of patients overall were on phosphate binders, and 15% were on calcitriol. Among patients who met diagnostic criteria for abnormal calcium-phosphorus metabolism, 60% were on some type of phosphate binder and/or calcitriol. The prevalence of treatment for abnormal calcium-phosphorus metabolism was higher among female patients and among patients with private insurance (80%), compared with patients who had other types (58 to 64%) and no (0%) insurance \((P < 0.05)\).

**Preparation for ESRD**

The majority of patients had documentation of discussion regarding the need for RRT for the first time at a predicted GFR \(<20\) ml/min per \(1.73\) m\(^2\), and the mean predicted GFR at the first recorded discussion was \(15\) ml/min per \(1.73\) m\(^2\). Among the 103 patients who were known to have progressed to the imminent need for RRT, 11% selected peritoneal dialysis, 80% selected hemodialysis, 4% were to go on to transplantation, and the outcome of the remainder could not be determined. Among these patients, 41% had permanent access placed before the initiation of dialysis. Among patients who

### Table 2. Prevalence of screening practices among patients with CRI

<table>
<thead>
<tr>
<th>Screening Test</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron studies</td>
<td>18</td>
</tr>
<tr>
<td>Albumin</td>
<td>72</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>69</td>
</tr>
<tr>
<td>Calcium</td>
<td>72</td>
</tr>
<tr>
<td>Parathyroid hormone level</td>
<td>15</td>
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<tr>
<td>Cholesterol</td>
<td>47</td>
</tr>
<tr>
<td>Triglyceride</td>
<td>33</td>
</tr>
<tr>
<td>Low-density lipoprotein</td>
<td>5</td>
</tr>
<tr>
<td>Glycosylated hemoglobin(^b)</td>
<td>28</td>
</tr>
</tbody>
</table>

\(^a\) Percentage with given laboratory value ever recorded among patients with first nephrology visit information available.

\(^b\) Among patients with diabetes.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Anemia(^b) (%, (n = 585))</th>
<th>Abnormal Ca-Phos Metabolism(^c) (%, (n = 463))</th>
<th>Hypoalbuminemia(^d) (%, (n = 231))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>38</td>
<td>55</td>
<td>22</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>34</td>
<td>52</td>
<td>16</td>
</tr>
<tr>
<td>female</td>
<td>42</td>
<td>58</td>
<td>26</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>white</td>
<td>36</td>
<td>54(^e)</td>
<td>24</td>
</tr>
<tr>
<td>black</td>
<td>55</td>
<td>76</td>
<td>22</td>
</tr>
<tr>
<td>Asian</td>
<td>43</td>
<td>36</td>
<td>0</td>
</tr>
<tr>
<td>other</td>
<td>62</td>
<td>91</td>
<td>22</td>
</tr>
<tr>
<td>Cause of renal disease</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>diabetes mellitus</td>
<td>49(^e)</td>
<td>59</td>
<td>33(^e)</td>
</tr>
<tr>
<td>hypertension</td>
<td>34</td>
<td>50</td>
<td>16</td>
</tr>
<tr>
<td>GN/PKD/IN</td>
<td>39</td>
<td>63</td>
<td>26</td>
</tr>
<tr>
<td>other</td>
<td>28</td>
<td>52</td>
<td>7</td>
</tr>
</tbody>
</table>

\(^a\) Among patients with information available at first nephrology visit who had relevant screening or medication at some time during study.

\(^b\) Anemia, pre-erythropoietin hematocrit <30%.

\(^c\) Abnormal calcium-phosphorus metabolism, parathyroid hormone level >100 pg/dl or phosphorus level >4.5 mg/dl, or use of calcitriol or binders at any time during study.

\(^d\) Hypoalbuminemia, serum albumin <3.5 g/dl on two or more occasions.

\(^e\) \(\chi^2\) \(P < 0.05\) for within-group comparison.
had planned access placement, this occurred at a mean of 157 days before the initiation of RRT. The mean predicted GFR at planned permanent access placement was 12.8 ± 4.9 ml/min per 1.73 m² and did not differ significantly on the basis of diabetic status or selected dialysis modality.

Discussion

It was estimated recently that 800,000 patients in the United States have serum creatinine levels ≥2 mg/dl and 6.2 million have serum creatinine levels ≥1.5 mg/dl (7). The Modification of Diet in Renal Disease Study demonstrated that renal function declined progressively at an average rate of 4 ml/min per yr in the majority of patients with GFR levels <55 ml/min per 1.73 m² (12). Taking these two studies together and that the U.S. population is aging (13), it can be predicted that the ESRD population will continue to increase in the future. The CRI population already under the care of physicians can be most readily targeted for interventions to improve the outcomes of patients with CRI and ESRD and reduce the costs associated with ESRD care.

The prevalence of CRI in the nephrology practices was 17%. The age and gender distribution of the CRI patients in this study was similar to that of patients starting ESRD therapy in the United States. The prevalence of HTN as the cause of CRI also was similar to the prevalence of HTN as the cause of ESRD in the United States. However, only 28% of the patients had diabetes as the cause of CRI, compared with 44% of patients starting ESRD therapy in the United States in 1997 (1). The mean serum creatinine and predicted GFR at the first nephrology visit were 3.1 mg/dl and 22.2 ml/min per 1.73 m², respectively. To our knowledge, the only published recommendation to date regarding timing of nephrology referral is the NIH 1994 Consensus Statement on Morbidity and Mortality of Dialysis, which suggests referral to a nephrology team when the serum creatinine is >1.5 mg/dl for women and >2.0 mg/dl for men (14). However, the creatinine level at which a nephrologist should first become involved in the care of patients with renal dysfunction is a hotly debated issue. Nevertheless, it is becoming increasingly clear that complications of CRI, such as hypoalbuminemia, abnormalities of calcium-phosphorus metabolism, and cardiovascular disease, begin early in the course of disease and are progressive in nature (15–18). Indeed, we found that 38% of patients had severe anemia (HCT <30%) during the study, and, among patients who were screened, 55% had or were treated for abnormalities of calcium-phosphorus metabolism, 42% had hypercholesterolemia, 22% had hypoalbuminemia, and 19% had acidosis at some time during the study.

An important aspect of care during CRI is the implementation of interventions to slow the progression of renal disease. ACE-I use has been demonstrated to retard the progression of renal failure among patients with diabetes, and this probably is true among individuals without diabetes as well (19,20). Clinical trials also have demonstrated that BP control, glycemic control among patients with diabetes, and perhaps dietary protein restriction retard the development and progression of renal insufficiency (21–23). In the current study, only 49% of patients were found to be on ACE-I at some point during the study follow-up. In particular, among patients with diabetes, only 65% were on ACE-I. This is despite unequivocal evidence that ACE-I slows the progression of CRI (19,24,25) and the National Kidney Foundation’s published recommendations for use of ACE-I among patients with diabetes mellitus who have microalbuminuria (26). The low rate of use of ACE-I among patients who are at risk has been reported in other situations. In a study of hospitalized Medicare patients in Atlanta, McClellan et al. (27) found that <35% of patients with diabetes and HTN with renal insufficiency had been prescribed ACE-I at discharge. Sixty-five percent of the patients in the current study were hypertensive, with two or more BP above the target level of 140/90 mmHg recommended in the fifth report of the Joint National Committee on Detection, Evaluation, and Treatment of High BP in 1993 (28). Among patients with diabetes, only 28% had a record of a HbA1C level to monitor adequacy of glycemic control. The results of this study suggest that impressive results from clinical trials on progression of CRI have not been translated fully into clinical practice, even in nephrology practices. However, it is possible that patients in whom a given intervention was not instituted may have had a contraindication for that therapy that was not captured in the data collection. It is also possible that an intervention recommended by the nephrologist may not have been implemented by the referring physician.

Optimal care during CRI includes prevention or attenuation of abnormalities and comorbid conditions associated with renal dysfunction. The majority of patients with progressive CRI invariably develop anemia, malnutrition, and abnormal calcium-phosphorus metabolism, and many have hyperlipidemia, all of which are associated with adverse outcomes among patients with CRI and ESRD (18,29–37). We found low rates of screening for many comorbid conditions or complications of uremia. Most patients had HCT, serum calcium, phosphorus, and albumin levels recorded, but very few had PTH and serum lipid levels recorded. It must be emphasized that these results may underestimate, because only testing at the nephrology clinic or after referral to nephrology was captured. Nevertheless, failure to screen suggests lack of identification and treatment of conditions that contribute to increased morbidity among patients with renal failure. In our study, 38% of patients had HCT <30% at some time during the study, but, among these, only 59% received rHuEPO. This compares to a prevalence of HCT <30% of 67% and of rHuEPO use of 23% at initiation of dialysis previously described in the population of patients beginning ESRD therapy in the United States between 1995 and 1997 (38). It is important to note that the Health Care Financing Administration authorizes reimbursement for the use of rHuEPO for patients with renal insufficiency after the HCT falls below 30%, and many other third-party payers follow Health Care Financing Administration policy. Thus, lack of reimbursement for rHuEPO should not be a cause for failure to use rHuEPO when indicated. The prevalence of hypoalbuminemia in the study population was 23%, which compares to a 60% prevalence at initiation of dialysis among patients beginning ESRD therapy in the United States (38). These data demonstrate that the hypoalbuminemia observed among pa-
tients starting dialysis begins early during the course of CRI. The prevalence of abnormal calcium-phosphorus metabolism was 55%; among these patients, 60% received a phosphate binder and/or calcitriol. This study confirms that anemia, hyperalbuminemia, and abnormal calcium-phosphorus metabolism are prevalent early during the phase of CRI and that these conditions may require increased attention.

The final component of optimal care during CRI is adequate preparation for ESRD therapy and timely initiation of dialysis. Patients who are educated early regarding the need for RRT are more likely to choose peritoneal dialysis (4,8,39,40). In the current study, only 11% of patients selected peritoneal dialysis, possibly related to the late stage of renal failure at which the first discussion of the need for RRT occurred. However, it must be emphasized that a discussion may have occurred earlier but was not recorded. Timely access placement enables the initiation of dialysis without further procedures in an outpatient or nonemergent manner; thus results in lower use of resources in the initial phases of ESRD (41–43). Forty-one percent of the patients who were identified as having progressed to the imminent need for RRT had placement of permanent access before start of RRT, which compares to the rates of >50% for the Michigan (44) and United States (4), population. Last, only 4% of patients who were approaching ESRD were recorded as going on to transplantation, although it is known that patients who have transplants have improved quality of life. Further improvement in patient education, rates of placement of vascular access before the initiation of dialysis, and rates of transplantation are likely to promote a better quality of life for the patients and may result in reduced cost of ESRD care.

There are several limitations of this study, which relate mostly to the source of the patient population. First, the Greater Boston area has a very high penetration of HMO, which may affect screening and referral practices; thus, the conclusions may not be readily generalized to the U.S. population with CRI. Second, the patient sample was derived from patients who were under the care of a nephrologist. Thus, the management practices of other physicians were not captured, and only the prevalence of CRI and its complications in nephrology practices was estimated, not that of CRI in the general population. Nonetheless, nephrology clinics are where patients with CRI are concentrated and hence are the ideal targets for strategies to improve management. Third, data were collected retrospectively; thus, there is great variability in the information and follow-up available on each patient. Notwithstanding these limitations, this report provides valuable information on a particular population that has not been well studied to date.

In summary, there is a relatively high prevalence of comorbid conditions among patients with CRI, and there seems to be room for improvement in the management of complications of CRI. An argument may be made that early interventions among patients with CRI could result in a slower rate of progression of renal insufficiency, reduction in the severity of renal and nonrenal comorbid conditions, smoother transition to ESRD, and possibly improved patient satisfaction. This ultimately could result in slowing the rate of rise in the incidence of ESRD; decline in the morbidity, mortality, and cost of ESRD care; and a better quality of life for patients. Evidence in support of the above could trigger significant changes in the practices of physicians who care for such patients and encourage third-party payers to commit resources toward early and comprehensive treatment of patients with CRI. The increased costs associated with early nephrology referral and intervention could be offset by reductions in the cost of ESRD care, in particular, the high cost in the first 6 mo of RRT. Future studies will be needed to accumulate evidence in support of the assumptions made above. Meanwhile, the nephrology clinic should be the first target for institution of care pathways to improve the clinical management of patients with CRI.

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