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Management of Chronic Kidney Disease in an Academic Primary Care Clinic

Ajay Israni[a, b] Cynthia Korzelius[c] Raymond Townsend[a] Douglas Mesler[c]

[a]Renal-Electrolyte, Hypertension Division and [b]Center for Clinical Epidemiology and Biostatistics, University of Pennsylvania School of Medicine, Philadelphia, Pa., and [c]Renal Division, Boston University School of Medicine, Boston, Mass., USA

Key Words

Chronic kidney disease · Management · Academic setting · Primary care clinic

Abstract

Background: Three million people in the United States are estimated to have chronic kidney disease (CKD). Management of these CKD patients in the outpatient primary care clinic setting has not been well studied. ***Hypothesis:*** Primary care management of CKD can be assessed and opportunities for improvement can be identified. ***Methods:*** Management of CKD based on available published literature and guidelines was assessed in a single primary care site of an academic hospital with 23,000 annual visits and 8,300 patients. Charts of patients seen between October 1, 1997 and March 25, 1999 with an elevated SCr ≥1.7 mg/dl on two separate measurements at least 6 months apart were reviewed for predefined indicators of CKD management. ***Results:*** Assessment identified several aspects of CKD management to be suboptimal: control of blood pressure, use of angiotensin-converting enzyme inhibitors or angiotensin receptor blockers, assessment of proteinuria, and renal consultation. Better management was found with respect to hemoglobin A1c measurement for diabetic patients. In general, CKD care was similar for diabetic and non-diabetic patients. CKD management was also similar regardless of level of creatinine clearance (≥50 vs. 50–30 vs. ≤30 ml/min). ***Conclusion:*** CKD care can be measured in an outpatient academic primary care clinic and opportunities to improve were identified.

Introduction

The population prevalence of chronic kidney disease (CKD) is now estimated, depending on the definition of renal insufficiency, from 3 to 20 million in the United States [1, 2]. While advantages of careful clinical management of this population have been suggested [3, 4], care delivery to this population has historically been 'below the radar', with care quality being assessed infrequently and incompletely [5, 6].

Prior to the recent release of the Kidney/Dialysis Outcomes Quality Initiative (K/DOQI) guidelines, few formal recommendations existed for the management of

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Ajay Israni, MD
One Blockley Hall
423 Guardian Drive
Philadelphia, PA 19104 (USA)
Tel. +1 215 573 2300, Fax +1 215 573 5535, E-Mail aisrani@cceb.med.upenn.edu

patients with CKD [2, 7–10]. However, the clinical literature had already suggested the importance of diabetes management [11], blood pressure control [12–15], angiotensin-converting enzyme inhibition (ACEI) [16], anemia management [17, 18], management of calcium metabolism [19–21], and timely referral to nephrologist [4, 5, 22].

Limited literature exists concerning outpatient CKD management [23, 24]. McClellan et al. [7] examined management of CKD patients in the inpatient setting. Kaiser Permanente has reported in a limited way results of its CKD screening and management program, however patients outside of the central practice/lab might not be captured in this laboratory-based program [25]. Nissenson et al. [6] advanced the literature considerably with their analysis of experience with CKD care in a large integrated staff and network model Health Maintenance Organization (HMO) from the Southwestern United States. However, nationwide, only 37.9% of all insured patients were enrolled in HMOs in 1999 [26]. Management of CKD across providers in an academic primary care clinic has not been described.

In this study we examine how CKD patients were cared for in an academic primary care clinic. We first identified patients with CKD and subsequently evaluated the clinical care they received. A laboratory screen was used to identify patients with elevated serum creatinine from the entire population visiting the clinic over a 12-month period. A chart abstraction tool based on available clinical literature was developed prior to chart review. Charts of patients with renal insufficiency were then examined and clinical data abstracted to measure care performance.

Patients and Methods

Study Design

This study was designed as a retrospective analysis of CKD care in an adult primary care site of an academic medical center in Boston with 23,000 visits per year and 8,300 patients. Care at this site is provided by attending physicians and residents under supervision of attending physicians. The study was approved by the Institutional Review Boards of Boston University and University of Pennsylvania. Information on study subjects was obtained from computer records and clinic charts. Using the computerized results of all laboratory tests ordered by the providers, we selected patients who had a serum creatinine (SCr) evaluated between October 1, 1997 and March 25, 1999, and whose creatinine level was $\geq$1.7 mg/dl on two occasions at least 6 months apart. One hundred and ten patients were identified with a single elevated index SCr. Fifty-six of these patients had a SCr $\geq$1.7 mg/dl on two separate measurements at least 6 months apart and thus fit our definition of CKD. This 6-month period and the SCr $\geq$1.7 mg/dl was chosen to allow primary care physicians adequate time to optimize the management of the CKD. These 56 patients were selected and their clinic charts were audited. Patients on dialysis were excluded.

Data Abstraction

Using predesigned forms, patients' charts were reviewed by C.K. for specific indicators of CKD management during the prior 12 months. Data was abstracted from the following sections of the chart: physician progress notes, medication list, and problem list. The demographic data recorded included age, sex, race, weight, and specific diagnosis of hypertension (HTN) or diabetes mellitus (DM). Clinic charts were reviewed for specific indicators such as recognition of CKD as a clinical problem by reviewing problem list or by mention of CKD in the assessment. Clinic charts were also reviewed for history of intolerance to ACEI and angiotension receptor blockers (ARB), use of any anti-hypertensive agents, and request for renal consultation. The following aspects of care were ascertained: systolic and diastolic blood pressure (SBP and DBP), prescription of ACEI or ARB drugs, and use of erythropoietin. Blood pressure readings were recorded from each clinic visit. We averaged the blood pressure readings from all clinic visits during the last 12 months.

Computer records from the 12 months prior to the index SCr were used to abstract the following data: urinalysis, measurement of microalbuminuria, measurement of spot protein to creatinine ratio, and glycosylated hemoglobin (HbA1c). Data pertaining to serum levels of calcium (Ca), phosphorus (PO_4), hematocrit (Hct), and albumin (Alb) were abstracted for those patients with a calculated creatinine clearance (CrCl) of <50 ml/min. We averaged laboratory values for proteinuria, Hct, Alb, Ca, and PO_4 that were performed during the last 12 months.

Analysis

We estimated the CrCl (in ml/min) using the Cockcroft-Gault formula [creatinine clearance = (140 – age) $\times$ body weight in kg/(SCr $\times$ 72)]. The value obtained from this formula was multiplied by 0.85 for female patients. Descriptive variables of patients in the following groups were analyzed: diabetics, non-diabetics, estimated CrCl $\geq$50 ml/min, estimated CrCl between 30 and 50 ml/min and estimated CrCl $\leq$30 ml/min. These patient groups were defined a priori. Numerical variables are shown as means $\pm$ SD unless otherwise specified. Normally distributed variables were analyzed by t test and ANOVA. Categorical values were analyzed by χ^2 tests and by Fischer's exact test when an individual cell size was <5. A p value of <0.05 was considered statistically significant. Statistical analysis was done using STATA 6.0 [27].

Results

Demographics

Fifty-six patients met our criteria for CKD. The demographics of the CKD patient group are shown in table 1. The mean age was 71 ($\pm$ 14) years and the mean weight was 84 ($\pm$ 16) kg. Thirty-six percent were female, 43% were white, 48% were black, and 9% were of other races. Twenty-five patients (45%) had DM and 52 (93%) had

HTN. The mean SCr was 2.3 (± 0.8) mg/dl and the mean calculated creatinine clearance (CrCl) was 39 (± 17) ml/min. Seventeen patients (30%) had a calculated CrCl ≤30 ml/min, 26 (46%) had a calculated CrCl between 30 and 50 ml/min, and 13 (23%) had a calculated CrCl ≥50 ml/min.

Calculated Creatinine Clearance and Serum Creatinine

The mean SCr for the group with the lowest calculated CrCl (≤30 ml/min) was 3.0 (± 1.12) mg/dl. This value was significantly larger than the mean SCr for the other two calculated CrCl groups ($p < 0.01$). The SCr was not statistically different between the two groups with higher calculated CrCl, however. The mean SCr for the group with calculated CrCl between 30 and 50 ml/min and for the group with calculated CrCl ≥50 ml/min were 2.0 (± 0.29) and 1.9 (± 0.13), respectively.

Hypertension and Blood Pressure Control

We analyzed 243 blood pressure readings, representing an average of four readings per patient during this period (table 1). The mean SBP was 144 (± 21) mm Hg and the mean DBP was 80 (± 11) mm Hg. Twenty-seven (48%) patients had a mean SBP >140 mm Hg and 8 patients (14%) had a mean DBP >90 mm Hg. On average, 2.6 anti-hypertensive medications were used per patient. Three patients (5%) were taking no anti-hypertensive medication. The mean SBP was >140 mm Hg in 31% of patients with calculated CrCl ≥50 ml/min, in 50% of patients with calculated CrCl between 50 and 30 ml/min, and in 59% of patients with calculated CrCl ≤30 ml/min ($p = 0.312$) (fig. 1).

Angiotensin-Converting Enzyme Inhibitor or Angiotensin Receptor Blocker Use

The frequency of use of angiotensin-converting enzyme inhibitors (ACEI) or angiotensin receptor blockers (ARB) in the entire CKD group was 41% (23 patients). ACEI or ARB was used in 54% of patients with calculated CrCl ≥50 ml/min, in 38% of patients with calculated CrCl between 50 and 30 ml/min, and in 35% of patients with calculated CrCl ≤30 ml/min (fig. 1). The use of ACEI or ARB was not statistically different among these patient groups ($p = 0.214$). The low frequency of ACEI or ARB use could not be completely attributed to intolerance, which was documented in only 10 of the 56 patients (18%). Two of the 10 patients with a history of ACEI or ARB intolerance were rechallenged and taking one of these medications at the time of the study.

Table 1. Characteristics of patients and the assessment of their care

Number of patients	56
Mean age, years (SD)	71 (±14)
Female, n (%)	20 (36)
Race	
White, n (%)	24 (43)
Black, n (%)	27 (48)
Others, n (%)	5 (9)
Mean CrCl, ml/min (SD)	39 (±17)
Patients with CrCl 30 ml/min, n (%)	17 (30)
Patients with CrCl >30 and <50 ml/min, n (%)	26 (46)
Patients with diabetes, n (%)	25 (45)
Patients with hypertension, n (%)	52 (93)
Mean systolic blood pressure, mm Hg	144 (±21)
Mean diastolic blood pressure, mm Hg	80 (±11)
Patients with SBP > 140 mm Hg, n (%)	27 (48)
Patients with DBP > 90 mm Hg, n (%)	8 (14)
ACEI or ARB used, n (%)	23 (41)
ACEI intolerance, n (%)	10 (18)
Urinalysis done, n (%)	30 (54)
Proteinuria quantitated, n (%)	11 (19)
Renal service consulted, n (%)	12 (21)

SD = Standard deviation.

Documentation of Chronic Renal Insufficiency as a Problem

Overall, chronic renal insufficiency (CRI) was recognized and documented in the problem list of 49 (88%) patients. CRI was documented as a problem in 77% of patients with calculated CrCl ≥50 ml/min, in 92% of patients with calculated CrCl between 50 and 30 ml/min, and in 88% of patients with calculated CrCl ≤30 ml/min ($p = 0.682$) (fig. 1).

Proteinuria Assessment and Quantification

Overall, 30 patients (54%) had a dipstick urinalysis for protein. This is likely an overestimate of the frequency of evaluation of proteinuria because urinalyses were probably done for other indications in some cases. Dipstick urinalysis was checked in 62% of patients with calculated CrCl ≥50 ml/min, in 42% of patients with calculated CrCl between 50 and 30 ml/min, and in 65% of patients with calculated CrCl ≤30 ml/min ($p = 0.308$) (fig. 1). Sixteen patients had an average protein measurement of one-plus or greater on dipstick testing (range for this test negative to four-plus). Eleven patients (19%) had documented urinary protein quantification by either 24-hour urine, spot urine protein to creatinine ratio, or quantitative

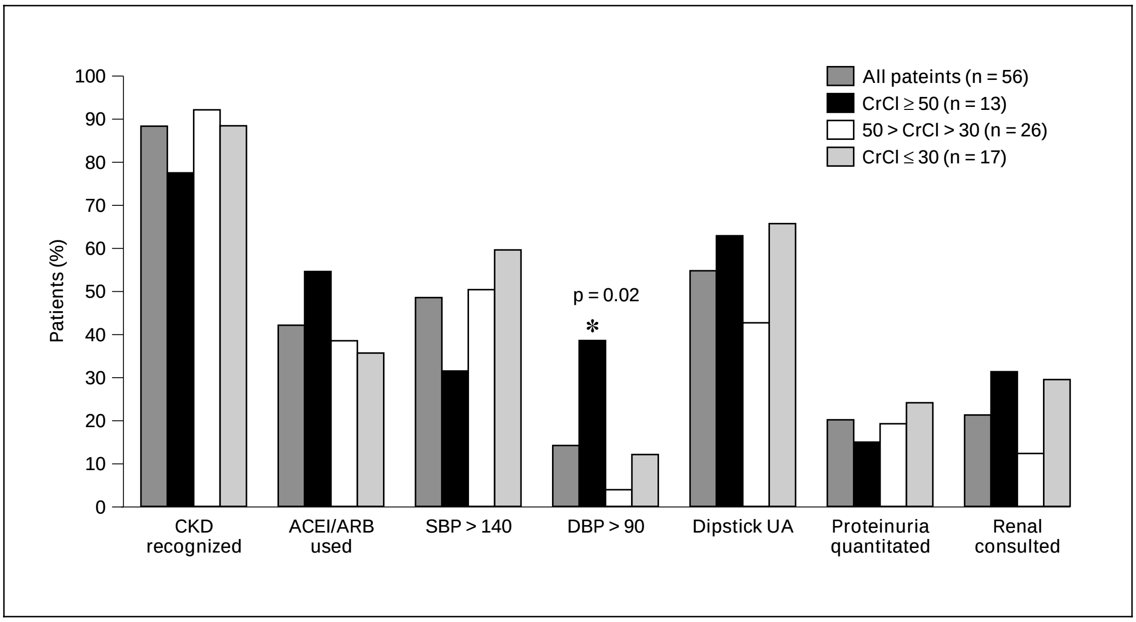

Fig. 1. Management of patients according to different estimated creatinine clearance was not significantly different. Only the percentage of patients with diastolic blood pressure >90 mm Hg (DBP > 90) was statistically different between different creatinine clearance groups (* p = 0.02, Fisher's exact test).

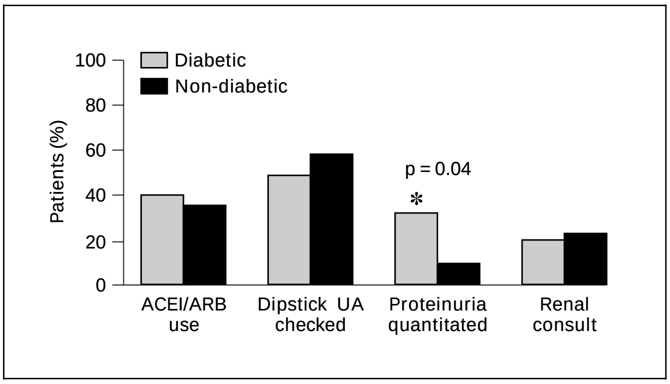

Fig. 2. Management of diabetics versus non-diabetics was not significantly different. Only proteinuria was more likely to be quantified among diabetics (* p < 0.05, Fisher's exact test).

microalbuminuria. Urinary protein was quantified in 15% of patients with calculated CrCl ≥50 ml/min, in 19% of patients with calculated CrCl between 50 and 30 ml/min, and in 24% of patients with calculated CrCl ≤30 ml/min (p = 0.914) (fig. 1).

Renal Consultation

Renal consultation was requested for 12 of the 56 patients (21%); in 31% of patients with calculated CrCl ≥50 ml/min, in 12% of patients with calculated CrCl between 50 and 30 ml/min, and in 29% of patients with calculated CrCl ≤30 ml/min (p = 0.214) (fig. 1).

Management of CKD in Diabetics

Of the 25 patients with DM, HbA1c was measured in 24 (96%) and the mean value was 8.0% (± 1.3%). The mean SCr did not differ significantly between diabetics and non-diabetics (SCr 2.0 ± 1.0 vs. 2.1 ± 0.8 mg/dl, respectively, p = 0.68), however the mean CrCl was significantly lower in diabetics (33 ± 13 ml/min vs. 43 ± 19 ml/min, p = 0.03). Diabetics and non-diabetics had similar average SBP (149 ± 23 vs. 140 ± 19 mm Hg, p = 0.12), however average DBP was significantly lower in diabetics (77 ± 10 vs. 82 ± 10 mm Hg, p = 0.07).

ACEI or ARB use was documented in 10 of 25 diabetics (40%) and in 11 of 31 non-diabetics (35%). This difference was not statistically significant (p = 0.73). The rate of ACEI or ARB intolerance was similar in both diabetics and non-diabetics, 16 vs. 19%, respectively (p = 0.74) (fig. 2).

Proteinuria was more likely to be quantified in diabetic patients. Quantification of proteinuria was performed in 8 (32%) diabetics versus 3 (10%) non-diabetics ($p = 0.04$). Performance rates of dipstick urinalysis and rates of renal consultation were not different between diabetics and non-diabetics (fig. 2).

Additional Care Measures for Calculated CrCl <50 ml/min

Additional analyses were performed for the 43 patients with CrCl <50 ml/min (table 2). Twenty-six patients (60%) had their serum calcium level checked (mean 9.1 ± 0.6 mg/dl, normal range 8.4–10.2 mg/dl), 13 (30%) had their serum phosphate level checked (mean 3.9 ± 0.9 mg/dl, normal range 2.7–4.5 mg/dl), and 4 (9%) had their serum albumin checked (mean 4.0 ± 0.3 mg/dl, normal range 3.5–4.8 mg/dl). The hematocrit was checked in 29 patients (67%) and 11 had an average value <33% (normal range 40–54%). Four of these 11 patients were prescribed erythropoietin. Of these 4 patients, 3 had a calculated CrCl of <30 ml/min and 1 had a calculated CrCl of 57 ml/min.

Table 2. Laboratory data for patients with CrCl <50 ml/min (n = 43)

Patients who had Ca checked, n (%)	26 (60)
Mean Ca level, mg/dl	9.1 (±0.6)
Patients who had PO_4 checked, n (%)	13 (30)
Mean PO_4 level, mg/dl	3.9 (±0.9)
Patients who had Hct checked, n (%)	29 (67)
Patients with Hct <33%, n (%)	11 (26)
Patients who had Alb checked, n (%)	4 (9)
Mean Alb level, mg/dl	4 (±0.3)

Discussion

The main finding of our study is that the management of CKD patients in an academic medical center does not always conform to recommendations from the published literature. Management of CKD patients was suboptimal for blood pressure control, use of ACEI or ARB, measurement of proteinuria, and rate of renal consultation. In contrast, HbA1c was measured in most of the diabetics as has been recommended.

The prevalence of CKD in our population is similar to the national prevalence of CKD. The prevalence of CKD, as defined in our study as two elevated SCr ≥1.7 mg/dl at least 6 months apart, is 0.7% (56/8,300 patients in clinic). However, the prevalence of CKD in our study population is higher if CKD is defined as a single elevated SCr ≥1.7 mg/dl. If all 110 patients with SCr ≥1.7 mg/dl are included, the prevalence of CKD rises to 1.3% (110/8,300 patients in clinic). This prevalence is comparable to the 1.2% prevalence described by the National Health and Nutrition Examination Survey III (NHANES). The NHANES data showed that the prevalence of CKD patients with a single SCr ≥1.7 mg/dl was 3 million (1.2% of a 250-million population) [1]. While a less stringent definition of CKD is appropriate for population epidemiologic studies, we felt our more rigorous definition was needed for the evaluation of patterns of clinical care.

Compared to previously described CKD populations, our CKD patients were older and had a significantly higher incidence of HTN and DM [23, 28]. In our CKD patients, the prevalence of HTN was 93% and the prevalence of DM was 45%, probably due to their high average age of 71 years. In prior published studies of CKD, the prevalence of HTN was 75–87% and the prevalence of DM 25% [23, 28].

At the time of recruitment into our study (prior to public release of K/DOQI for CKD) consensus was emerging and recommendations had been published that supported certain routine practices in this population, and specifically in diabetics. In fact, the National Institute of Diabetes and Digestive and Kidney Diseases of the National Institutes of Health had published, in a workshop report, recommendations for the prevention of progression of nephropathy in patients with and without diabetes in 1995 [9]. The workshop recommended blood pressure management to the level suggested in Joint National Committee V (130/85) and to a lower goal of 125/75 mm Hg for those with >1 g/24 h proteinuria (these more aggressive targets were endorsed in the JNC VI recommendations released in 1997), and that proteinuria should be quantitated in diabetics and if present, ACEI considered. From this and other existing recommendations, we chose the following care measures for evaluation in our population: measurement of HbA1c, measurement of proteinuria, control of hypertension, ACEI or ARB use, and measurement of anemia and calcium and phosphorus levels in patients with GFR <60 ml/min/1.73 m^2. The K/DOQI guidelines for CKD released to the public in 2002 subsequently incorporated guidelines similar to all these care measures. Thus, the new K/DOQI guidelines support the CKD care measures used in our study.

We found the care of CKD was uneven, sometimes conforming to published literature and oftentimes not. The care of CKD was optimal with respect to the assessment of HbA1c. In addition, the recognition of CKD was high at 88% in our study. However, the indicators of CKD care were suboptimal for the following: control of blood pressure, use of ACEI or ARB, assessment of proteinuria (routine dipstick and quantitative), and rate of renal consultation. Overall, we identified several clinically important differences between the observed care of CKD and previously published recommendations. The majority of primary care physicians had identified CKD as a clinical problem (88%), so lack of recognition is not likely the explanation of suboptimal CKD care.

The assessment of HbA1c in our patients was much better than that in other studies. Ninety-six percent of our diabetic patients had their HbA1c checked, with these patients exhibiting a good level of control. In sharp contrast, Peters et al. [29] reported poor compliance with HbA1c monitoring. Peters et al. analyzed the quality of diabetes care in a large health management organization (HMO). They found that 56% of diabetics had no HbA1c checked and 40% of those with measured HbA1c had a level >10%.

In our CKD patients, the management of blood pressure and the use of ACEI or ARB was suboptimal, although better than that found in some studies. In our group, 48% of the patients had a SBP >140 mm Hg and 14% had a DBP >90 mm Hg. In contrast, the NHANES cohort had blood pressures that were not well controlled in 73% of patients [30]. In our study, 41% of the patients had been treated with an ACEI or ARB. Another 14% had been tried on these agents but could not tolerate them. Clinical practices have been analyzed in terms of adherence to recommendations for use of ACEI in diabetic patients with HTN or proteinuria. In a chart audit of diabetic patients enrolled in five Arizona Medicare managed care plans, only 23% of diabetic patients with hypertension were on ACEI. About one-third of the diabetics with gross proteinuria or microalbuminuria were also on ACEI [31]. In a large HMO in New Mexico, only 31% of CKD patients seen by a nephrologist were on an ACEI [28]. Another group recruiting 133 diabetic patients for a controlled trial of diabetes nurse case management program in a group model HMO found that only 39% of the study participants were on ACEI [32]. A study of nephrology practices in the Northeastern United States showed that only 49% of their CKD patients were on an ACEI [23]. However, these prior studies have not reported the prevalence of ACEI or ARB intolerance in their CKD populations.

We expected the management of diabetics in our CKD study to be better than that for non-diabetics due to the predominance of prior literature on proteinuria and blood pressure management in this group [11, 16]. We found that the DBP was significantly lower in the diabetics, however, the SBP was no better for diabetics than non-diabetics. Overall, the rate of proteinuria assessment by dipstick was low at 54% and did not differ substantially between diabetic and non-diabetic patients. Other studies report a similarly low rate of proteinuria assessment in HMOs [29, 33].

In our study, proteinuria was quantitated (either by 24-hour urine, spot protein to creatinine ratio, or quantitative microalbuminuria) more often in diabetics than in non-diabetics, although the overall rate, even for diabetics, was low. Other studies in diabetics report that proteinuria was quantitated in 5–31% of HMO patients [31, 32, 34]. We are aware of no other studies which compare proteinuria measurement between diabetic and non-diabetic subgroups.

We expected the management of CKD in our study to be most intense in the group with lowest CrCl. However, the use of ACEI or ARB, assessment of proteinuria, quantification of proteinuria, and rate of renal consultation was not significantly different in those patients with the most advanced renal insufficiency. The low rate of renal consultation, even in the lowest CrCl group in our CKD study, is consistent with the pattern of late referral for initiation of dialysis documented by others [22, 24].

When the estimated CrCl was <50 ml/min, we also looked for other quality of care items such as erythropoietin use, assessment of laboratory parameters for Hct, Alb, Ca, and PO_4. We found the measurement of these parameters to be variable ranging from 67% for Hct to 9% for serum albumin. When measured, the Hct was <33% in 26% of our patients with a CrCl <50 ml/min. A similar level of anemia was reported in 29% patients with CKD in a large New Mexico HMO [28]. Kausz et al. [23] reported that 38% of patients had a Hct <30% in their analysis of nephrology practices in Northeastern United States. Only 4 of our 11 patients with Hct <33% were prescribed supplemental erythropoietin.

This study demonstrates the feasibility of employing selected care measures to examine CKD management practices in a primary care setting. Limitations to generalization of our results exist including the small sample size, the cross-sectional form of the data, and the retrospective nature of the analysis. The use of less stringent criteria for CKD would have increased our sample size but at the expense of specificity. A larger study population could also have been generated through examination of a larger primary care population or by observation over a longer period of time. Indeed, this study was neither designed nor powered to evaluate the significance of differences in specific care measures among patient subgroups. However, the study does demonstrate the feasibility of care assessment using standardized abstraction tools, and the potential of this measurement for improving care quality. While cross-sectional analyses do not document care for individual patients across the time continuum, changes in cross-sectional data could reflect changes in practice as applied to individual patients [35].

In conclusion, we found that several aspects of care of CKD patients in this primary care setting were in poor compliance with recommendations from published literature. These included suboptimal control of blood pressure and use of ACEI or ARB and infrequent measurement of proteinuria and rate of renal consultation. The potential for improving care in these areas is illustrated by the excellent compliance with HbA1c measurement, a care measure for which there has been a strong and consistent message from many groups for nearly a decade. Well-focused and publicized medical education and quality improvement efforts are needed to improve the quality of CKD care in primary care clinics. Similar standardized abstraction tools may be useful in the future to document changes in practice, for example after the new K/DOQI guidelines for CKD are disseminated to primary care physicians.

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