One day the Nouns were clustered in the street. An Adjective walked by, with her dark beauty. The Nouns were struck, moved, changed. The next day a Verb drove up, and created the Sentence.
For this year’s Annual Data Report we have developed an expanded chapter for the Special Studies Centers, presenting assessments by the Cardiovascular, Rehabilitation/Quality of Life, and Nutrition centers.

This year’s presentation by the Cardiovascular Special Study Center concentrates on diagnostic testing and treatment for cardiovascular disease. The first figures look at congestive heart failure, history of acute myocardial infarction, and diabetes among patients receiving diagnostic testing and treatment for cardiovascular disease. Interestingly, the peritoneal dialysis and transplant patients who receive these diagnostic tests have similar burdens of these diagnoses, while the burden is heavier among patients receiving hemodialysis.

In the dialysis population the use of stress testing, coronary angiography, or the combined evaluations doubled between 1995 and 2005. Use in the transplant population, in contrast, is up 70 percent, but these tests reach only 13 percent of Medicare patients. Similar growth has occurred in echocardiography testing across ESRD modalities in the first 12 months of incidence, but at three years after initiation just 46, 37, and 34 percent of hemodialysis, peritoneal dialysis, and transplant patients have received this test. The use of lipid testing is similar in hemodialysis and peritoneal dialysis patients, but lags behind in those with a transplant—even though cardiovascular disease is a major cause of death among transplant patients.

Data on the use of revascularization procedures also show important contrasts by modality. Percutaneous coronary interventions, for example, have more than doubled in the dialysis population, but this is not the case for transplant patients. This may reflect better pre-transplant evaluations and interventions that would lessen the likelihood of post-transplant interventions. At three year after transplant, however, the percentage of transplant patients receiving revascularization is just one-third as high as in the dialysis population.

Assessing the use of tests to evaluate cardiovascular disease, along with the types of interventions used, provides important insights into the delivery of care. In the 2009 ADR the Cardiovascular SSC will continue to assess these and other aspects of cardiovascular disease care.

This year the Rehabilitation/Quality of Life and Nutrition Special Studies Centers present preliminary data from the Comprehensive Dialysis Study, assessing the incident population entering ESRD treatment. This study was carried out across the U.S., and is described on page 152.

In the population younger than 55, 50–60 percent of those with a high school or college education worked prior to ESRD. Fewer than 20–25 percent, however, were working after the start of ESRD. Almost 80–90 percent of those younger than 55 had applied for or received Social Security disability benefits once starting ESRD. Physical and mental function scores are low, in contrast to the general population, and consistent with other published data on the dialysis population.

The nutritional assessment of the CDS population is presented in Figures 9.23–28, and ranges from serum albumin levels to energy and protein intake. Inflammatory load, as reflected in C-reactive protein levels, is quite variable across gender and age groups. And with only a few exceptions, energy and protein intake are below recommendations for most age and gender groups.

In future ADRs these preliminary data will be integrated and merged with information on functional status and quality of life, addressing interactions between nutrition and self-reported health status.
figure 9.1 incident Medicare dialysis patients & first transplant patients age 20 & older.

highlights

figure 9.2 At least 60 percent of hemodialysis patients undergoing diagnostic testing for cardiovascular disease have a history of comorbid congestive heart failure. figure 9.6 In 1995, approximately 16 percent of incident hemodialysis and peritoneal dialysis patients received a stress test or coronary angiogram within a year after initiating ESRD therapy. This rose to approximately 25 percent by 2005. figure 9.15 In the Comprehensive Dialysis Study, younger patients and those with college education were more likely to work for pay prior to dialysis than were older patients and those with a high school or lower education. figure 9.18 Younger and less educated patients in the Comprehensive Dialysis Survey were more likely to receive or apply for Social Security benefits.

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Cardiovascular diagnosis & testing
A report from the USRDS
Cardiovascular Special Studies Center

The contribution of the Cardiovascular Special Studies Center (CVSSC) to this year’s Annual Data Report fits the new division of the ADR into two volumes, a new one addressing chronic kidney disease and the traditional book focusing on end-stage renal disease. In keeping with the collaborative work of the three special studies centers (and the upcoming USRDS Special Study), this chapter also represents the first attempt of the three Special Studies Centers to contribute jointly to a single chapter reflecting their respective areas of interest.

Cardiac disease continues to be the single largest contributor to all-cause mortality in patients with ESRD, and for this reason the CVSSC is presenting an overview here relating to areas of special interest for diagnosis and treatment of cardiovascular disease in ESRD patients. Similar information is presented in Volume One, as cardiac disease is also an important contributor to morbidity and mortality in CKD patients. Due to their particularly large burden of cardiovascular disease, however, it is appropriate to focus separately on ESRD patients.

One major task of the CVSSC is to continue identifying and characterizing temporal trends in the diagnosis and treatment of cardiovascular disease in ESRD patients. There are several reasons for this long-term interest. The implementation of effective, evidence-based clinical strategies is a key issue in the effective management of cardiovascular disease in this high-risk ESRD population. An analysis of temporal trends permits a broad overview of the use of these clinical strategies, and is hopefully a means of calling attention to areas of potential improvement.

A good example of this issue relates to the use of echocardiography in dialysis patients. Guideline 1.1a of the K/DOQI Clinical Practice Guidelines for Cardiovascular Disease in Dialysis Patients (NKFD 2005) recommends that “Echocardiograms should be performed in all patients at the initiation of dialysis, once patients have achieved dry weight (ideally within one to three months of dialysis initiation), and at three yearly intervals thereafter.” The rationale for this evidence-based guideline is that the identification of cardiomyopathy (including diminished ejection fraction) is prognostically important. In patients with diminished ejection fraction and cardiomyopathy, the administration of the beta blocker carvedilol has been shown to improve outcome in dialysis patients (Cice et al., 2003).

Guideline 6.1d, in the same K/DOQI guidelines, address the evaluation of cardiomyopathy in dialysis patients, extending the blanket recommendation for evaluation of left ventricular systolic function in dialysis patients to include re-evaluation at the time of screening for kidney transplantation.

It has now been more than three years since the final publication of the K/DOQI practice guidelines on the management of cardiovascular disease in dialysis patients, and one major focus of the CVSSC has been to track the potential impact of the publication on clinical practice. Supporting the prescient content of the guidelines, a recent article by de Mattos, et al. (2008) highlighted the strong graded association between depressed left ventricular ejection fraction and mortality in renal transplant candidates. It has been the informal impression of the CVSSC that the implementation and acceptance of the K/DOQI Clinical Practice Guidelines for Cardiovascular Disease in Dialysis Patients has not been universal.

The CVSSC will continue to highlight temporal trends relating to the implementation of clinical strategies for the diagnosis and treatment of cardiovascular disease in ESRD patients. Ultimately, it is our belief that this focused attention will lead to the better treatment of cardiovascular disease in ESRD patients.
Comorbid cardiovascular disease plays a key role in the increased hazard of cardiovascular death in ESRD patients. Patients with diabetic ESRD are at significantly higher risk for all types of cardiovascular morbidity and mortality, and for this reason diabetes merits special attention as a contributor to adverse outcomes, as do congestive heart failure (CHF) and acute myocardial infarction (AMI). At least 60 percent of hemodialysis patients undergoing diagnostic testing for cardiovascular disease have a history of comorbid CHF. This number rises to 70 percent of patients having echocardiography, and 74 percent of those undergoing coronary angiography. Although CHF is a frequent comorbid condition in peritoneal dialysis and transplant patients, it occurs less often than among hemodialysis patients. Only 51 percent of peritoneal dialysis patients with echocardiograms, and 52 percent of those with coronary angiography, have comorbid CHF.

A history of AMI is less frequent, but still an important contributor to comorbid cardiovascular illness. Approximately 25 percent of hemodialysis patients with a stress test or coronary angiography have a history of AMI — 73 percent, however, have a history of diabetes. Similar patterns are evident for comorbid illness in patients receiving therapies for cardiovascular disease. Approximately three in four patients receiving coronary revascularization have comorbid CHF, compared to one in two peritoneal dialysis and transplant patients. A history of AMI is present in 45, 43, and 47 percent of hemodialysis, peritoneal dialysis, and transplant patients receiving treatment for cardiovascular disease. Not surprisingly, nearly all dialysis patients have a history of identified CHF prior to implantation of an ICD (implantable cardioverter defibrillator) or CRT-D (cardiac resynchronization therapy with defibrillator) device.
Diagnosis of cardiovascular disease

**9.4** Stress testing incident dialysis & first transplant patients age 20 & older

**9.5** Coronary angiography incident dialysis & first transplant patients age 20 & older

**9.6** Stress testing or coronary angiography incident dialysis & first transplant pts age 20+

**9.7** Echocardiograms incident dialysis & first transplant patients age 20 & older

**9.8** Electrocardiograms (ECG) incident dialysis & first transplant patients age 20 & older

**9.9** Lipid testing incident dialysis & first transplant patients age 20 & older
There has been a progressive increase in the use of diagnostic procedures to detect coronary artery disease. In 1995, approximately 16 percent of incident hemodialysis and peritoneal dialysis patients received a stress test or coronary angiogram within a year after initiating ESRD therapy. This rose to approximately 25 percent by 2005. Among transplant patients the rate has grown from 10 to 13 percent.

Echocardiography use (a primary interest of the CVSSC, because of the K/DOQI Clinical Practice Guidelines) has also increased progressively over time. In 1995, 33, 27, and 23 percent of incident hemodialysis, peritoneal dialysis, and transplant patients, respectively, received an echocardiogram within one year of beginning ESRD therapy. By 2005, these numbers had grown to 43, 35, and 31 percent. The 2005 benchmark is of particular interest, as the K/DOQI Clinical Practice Guidelines were published during this year. It will be of particular interest to track future echocardiography use in this patient population, as the 2005 data reflect clinical practice at the time the guidelines were published.

One diagnostic test that has not shown an increase in use is electrocardiography; testing rates have changed little over the last ten years.

Although the overall use of revascularization procedures appears to be low, these data reflect the entire ESRD population across all age groups. As the risk of coronary artery disease is considerably higher in older patients, the utilization rate increases if the population of interest is restricted to older patients. Data reflect the larger national trend of a progressive increase in PCI for the treatment of CAD, which is not paralleled by surgical revascularization. In 1995, 1.5 percent of all hemodialysis patients underwent PCI within a year of ESRD initiation; this rose to 3.6 percent in 2005. In contrast, 1.2 percent received surgical therapy in 1995, and this was essentially unchanged a decade later.

The most dramatic increase — that seen for device therapy in dialysis patients — reflects recent and rapid technological advances. Although the percent of patients receiving devices is still quite small, the proportional increase is relatively large. In 1995, only 0.06 percent of hemodialysis patients received device therapy within a year of initiating ESRD therapy. Ten years later, this has increased more than tenfold to 0.75 percent. It is noteworthy that, in 2005, 1 in 133 incident hemodialysis patients in the U.S. received a new ICD or CRT-D device. It is likely that this trend will continue.
The Comprehensive Dialysis Study
A USRDS Special Study from the Rehabilitation/
Quality of Life & Nutrition Special Studies Centers

Special data collection studies of the USRDS enhance and enrich the existing database. Information about behavior, perceived functioning, and well-being reported directly by patients is especially important in a chronic disease population. The Comprehensive Dialysis Study (CDS) is a special data collection study that focuses on physical activity level, health-related quality of life, and work/disability status reported by patients who have recently started maintenance dialysis. In a subset of participants, dietary intake and nutritional status were also assessed. A primary goal of the CDS is to better understand the interrelations among general health, nutrition, physical function, and health-related quality of life, in order to inform the design of interventions to prevent or correct deficiencies in these parameters.

A random sample of maintenance dialysis facilities was selected for the study, stratified by ESRD network and by state within the networks. The selected sample matched the population closely on facility type, chain/non-chain designation, and dialysis modalities offered. Incident patients at the selected dialysis facilities were identified by the CMS Standard Information Management System (SIMS) and asked to participate in the study. All consenting patients were asked to respond to a Patient Questionnaire. Patients from a pre-identified subset of facilities were also asked to contribute to a nutrition study, reporting dietary intake in a Food Questionnaire and providing quarterly 15 ml serum samples for laboratory studies that are linked to nutritional status and inflammation but not routinely measured in dialysis practice.

Examples of standardized interview categories in the CDS Patient Questionnaire (1,646 participants) include demographics (including education), dialysis treatment characteristics, perceived health status/quality of life, activity/exercise capacity and patterns, employment status, Social Security disability status, and a depression screener. The Food Questionnaire (361 participants) includes current weight and height, vitamin use and history, daily nutrients from food, grams of solid food per week, calorie sources, fiber sources, and daily food group servings.

Trained interviewers at DataBanque Research Services (Pittsburgh, Pennsylvania) administered a Patient Questionnaire and a Food Questionnaire to participants in English or Spanish, using a Computer-Assisted Telephone Interviewing (CATI) system. The Patient Questionnaire database was then sent to the USRDS Coordinating Center (CC). Dietary intake data from the Food Questionnaire were processed by NutritionQuest (Berkeley, California), then sent to the USRDS CC. Serum samples were shipped to the Nutrition Special Studies Center laboratory in Davis, California, for analysis, and the results were then sent to the USRDS CC.

The CDS represents the largest dataset obtained from incident dialysis patients that contains detailed information on self-reported physical activity and macronutrient intake, as well as one of few cohorts simultaneously measuring laboratory proxies of nutrition and inflammatory status. Information reported by CDS participants can be linked with patient-specific clinical information recorded on the Medical Evidence form at the initiation of treatment, as well as with patient-specific modality histories and data on hospitalization, mortality, and costs in the USRDS files. These data will help improve understanding of the best ways to reduce complications, disabilities, death, and the economic costs of chronic kidney disease.
**Summary of Incidence Study**

The Comprehensive Dialysis Study (CDS) participants included 1,646 incident patients, with demographics as follows:

- **Age at Dial. Initiation, Mean (SD):** 60.2 (14.2) years
- **Age Range (Years):** 19–94
- **Male (%):** 55.1
- **African American (%):** 27.4
- **Hispanic (%):** 16.5
- **Hemodialysis (%):** 89.7

**Geographic Distribution of Dialysis Units**

- **Figure 9.13:** Equal probability systematic random sampling was used to select 335 dialysis units from which patients were asked to participate in the CDS. Patients who participated were affiliated with 295 of these units, located across all 18 networks and in all 50 states and the District of Columbia, except Vermont and Alaska. The maximum number of dialysis units represented in a state ranged from 8 to 28. Three-fourths of the 295 units were chain-affiliated. The majority (90 percent) were free-standing non-hospital renal disease treatment centers; there were also 18 short-term hospitals and 11 hospital-owned and/or operated kidney disease treatment centers.

- **Figure 9.14:** Because it was not feasible to collect detailed dietary intake data and serum samples from patients affiliated with all CDS dialysis units, subsample units were selected from which patients were asked to participate in the nutrition sub-study along with answering a Patient Questionnaire. Systematic sampling was used to maximize the number of nutrition sub-study patients. There were 361 patients at 68 units who participated in the sub-study at baseline. These 68 units, located across all 18 networks, were concentrated among free-standing non-hospital renal disease treatment centers (97 percent). The maximum number of nutrition sub-study dialysis units in a state ranged from 5 to 9.

**Table 9.a** The characteristics of patients in the Comprehensive Dialysis Study closely match those in the overall population of patients initiating dialysis in 2005. The average patient vintage at the time of the interview was four months. The subset of patients who also provided nutrition information had similar characteristics.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at Dial. Initiation, Mean</td>
<td>60.2 (14.2)</td>
</tr>
<tr>
<td>Age Range (Years)</td>
<td>19–94</td>
</tr>
<tr>
<td>Male (%)</td>
<td>55.1</td>
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<tr>
<td>African American (%)</td>
<td>27.4</td>
</tr>
<tr>
<td>Hispanic (%)</td>
<td>16.5</td>
</tr>
<tr>
<td>Hemodialysis (%)</td>
<td>89.7</td>
</tr>
</tbody>
</table>

**Table 9.a & Figures 9.13–14** Incident patients participating in the Comprehensive Dialysis Study (CDS), 2005–2007.
During the year before starting dialysis, at least half of CDS patients younger than age 55, and one-fifth of those age 55 or older, were working for pay, either full- or part-time. (Working for pay was defined as receiving taxable wages.) Patients with a college education were more likely to report working than patients with a high school or lower education. After starting dialysis, the proportion of patients in both age groups who reported that they were working for pay was much lower. Slightly more than one-fourth of patients younger than 55 with college education reported that they were employed; this was the group most likely to report that they were currently working.

Patients were more likely to say that they were now able to work for pay than to report that they were actually working. This was true in each age and education category. More than three-fourths of patients younger than 55, and 45–55 percent of those 55 and older, were either receiving disability benefits or had applied to receive such benefits from Social Security.
The Physical Component Summary (PCS) score, which summarizes physical dimensions of health status from the Medical Outcomes Study Short Form-12 (MOS SF-12) health status survey, is normalized to a general U.S. population mean of 50. Dialysis patients’ PCS scores were below the average for the general population, and women had lower PCS scores than men regardless of age. Women were also less likely than men to report walking frequently for exercise. Dialysis patients’ average PCS scores were similar to the average score of Medical Outcomes Study patients with a serious medical condition (36.2). In the general population, about 38 percent of adults with a PCS score of 35–39 are limited in walking one block, but 60 percent or more of dialysis patients reported that they did not walk frequently for exercise.

The Mental Component Summary (MCS) score, which summarizes dimensions of mental health from the MOS SF-12 health status survey, is also normalized to a general U.S. population mean of 50. Dialysis patients’ MCS scores were higher than their PCS scores, but below the average for the general population. Probable or possible depression, measured by the Patient Health Questionnaire-2 (PHQ-2) depression screener, was more often reported by patients younger than 65 than by those 65 or older. Patients younger than 65 also had lower MCS scores. Within age categories, men and women were similar on these two measures of mental health status.

Dialysis patients’ average MCS scores were similar to the MCS score of Medical Outcomes Study patients with both a psychiatric and a serious medical condition (41.7). A lower MCS score and higher incidence of depressive symptoms among younger patients as compared to older patients suggest that younger patients have greater difficulty adjusting to life on dialysis.
Laboratory data

Serum albumin, by age & gender

Prealbumin, by age & gender

C-reactive protein, by age & gender

Alpha 1 acid glycoprotein, by age & gender

Figures 9.23–26 Serum samples were obtained at baseline for 269 patients at 66 facilities (76 percent of participants in the nutrition substudy). Albumin, prealbumin, C-reactive protein (CRP) and alpha 1 acid glycoprotein (α1 AG) were measured by nephelometry. Albumin and prealbumin were higher in men than women and tended to decline with age. Albumin and prealbumin were correlated with each other ($r^2 = 0.31$), and each was negatively correlated with the natural logarithm of CRP and negatively correlated with alpha 1 AG, although to a lesser extent ($r^2 = 0.1$).
figures 9.27–28 Three hundred sixty-one patients completed a Food Frequency Questionnaire. Except for the youngest patients, protein and energy intake were higher among men than women, even after normalization for body weight. Nutritional guidelines for dialysis patients recommend a daily protein intake of 1.2 g/kg/day and energy intake of 35 kcal/kg/day for individuals under 60 years of age, and 30–35 kcal/kg/day for those over age 60. Protein intake estimated using this questionnaire fell short of recommended levels for 78 percent of individuals, and energy intake was less than desirable for 86 percent.
chapter summary

1 in 6
Dialysis pts receiving a stress test/coronary angiography in the first year of ESRD (9.6)

1 in 4
2005

43%
2005

33%
1995

Hemodialysis patients receiving an echocardiogram in the first year of ESRD (9.7)

35%
2005

27%
1995

Peritoneal dialysis patients receiving an echocardiogram in the first year of ESRD (9.7)

31%
2005

23%
1995

Transplant patients receiving an echocardiogram in the first year of ESRD (9.7)

1 in 133
Incident hemodialysis patients receiving a new ICD/CRT-D device (9.12)

3.6–3.7%
2005

1.5%
1995

Dialysis patients receiving PCI in the first year of ESRD (9.10)

1.2%
1995

Dialysis patients receiving surgical revascularization in the first year of ESRD (9.11)

51%)
Prior to ESRD

11%
Currently

CDS patients age <55 who work for pay: high school education or less (9.15–16)

65%
Prior to ESRD

27%
Currently

CDS patients younger than 55 who work for pay: college education (9.15–16)

3 in 10
Age <65

2 in 10
Age ≥65

CDS patients with probable or possible depression (9.22)

6.9
Male

5.6
Female

Median C-reactive protein in CDS patients age 45–54 (mg/l; 9.25)