The epidemiology of ESRD is well characterized. For nearly two decades the United States Renal Data System has provided ongoing analysis of the incidence, prevalence, treatment, morbidity, and mortality of ESRD on the basis of systematic data collection by the Centers for Medicare and Medicaid Services and the 18 ESRD Networks. These data have been critical in defining the growth of the ESRD population in the United States, documenting trends in treatment, and stimulating improvement in multiple aspects of ESRD care.

Similar national data regarding the epidemiology of acute kidney injury (AKI) are not available, although its epidemiology has been described at single centers and across limited geographic regions. In a study conducted during the late 1970s, Hou et al. (1) observed hospital acquired renal insufficiency during 4.9% of hospitalizations at a single academic medical center, using as a definition of AKI an increase in serum creatinine of ≥0.5 mg/dl in patients with a baseline serum creatinine of ≤1.9 mg/dl, of ≥1 mg/dl in patients with a baseline serum creatinine between 2 and 4.9 mg/dl, and of ≥1.5 mg/dl in patients with a baseline serum creatinine ≥5 mg/dl. Nearly two decades later, using the same criteria for AKI, albeit at a medical center in a different city, Nash et al. (2) observed that the frequency of hospital-acquired acute kidney disease had increased to 7.2% of hospitalizations. Using similar criteria, Kaufman et al. (3) reported that community-acquired AKI is present at the time of hospital admission in 0.9% of patients, noting a markedly greater frequency of prerenal and obstructive causes than observed in the two series of hospital-acquired AKI. Lower estimates of the incidence of AKI have been provided by studies using more stringent definitions. Using an increase in serum creatinine of ≥0.9 mg/dl when the baseline serum creatinine was <2 mg/dl or an increase of ≥1.5 mg/dl when the baseline serum creatinine was ≥2 mg/dl, Shusterman et al. (4) observed AKI in 1.9% of medical, surgical, and gynecologic patients who were admitted to a single academic medical center. With an even more stringent definition, a sudden increase in serum creatinine of ≥2 mg/dl in patients with a baseline serum creatinine of ≤3 mg/dl, Liaño et al. (5) identified 748 episodes of AKI during 200,464 hospital admissions to the 13 tertiary care hospitals in Madrid, Spain, giving an incidence of 0.37%. All of these studies relied on data from tertiary care centers; data on a broader hospital population have not been available.

In this issue of CJASN, Liangos and colleagues analyze data from the National Hospital Discharge Survey, a nationally collected sample of approximately 330,000 inpatient admissions from >500 hospitals across the United States, to assess the national incidence and outcomes of AKI (6). On the basis of International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) coded discharge records, they calculate an incidence of AKI in hospitalized patients of 1.9%. When projected over the estimated >29 million hospital discharges in the United States per year, this corresponds to >550,000 episodes of AKI annually. Not surprisingly, they found that patients with AKI were more likely to have sepsis or other nonrenal acute organ system dysfunction. Only 7.5% of patients with AKI required renal replacement therapy. Mortality in patients with AKI was 21.3%, as compared with only 2.3% across all patients in the National Hospital Discharge Survey database. Similarly, AKI was associated with a longer median hospital length of stay (7 versus 3 d for all patients), the longest as compared with all other single acute organ system dysfunctions. The length of stay for patients who required renal replacement therapy was longer than for patients who did not require renal replacement therapy. After multivariate adjustment for demographic factors, coexisting conditions and other acute organ system dysfunction, AKI was associated with two-fold higher odds for transfer to a short- or long-term care facility and with 4.1-fold higher odds for death during hospitalization.

The differences between the incidence of AKI observed in this study and the values reported in earlier studies most likely are related to issues of case identification, with the reported rate of 1.9% falling in an intermediate range between studies that defined AKI on the basis of small increments in serum creatinine and studies that used more substantial increases to define acute injury. The observed mortality rate in this study was comparable to that observed by Hou et al. (1) and by Nash et al. (2), although substantially lower than that observed by Liaño et
al. using a more stringent definition of AKI (5). It is important to note, however, that all of these previous studies were of patients at tertiary care centers; this study by Liaño et al. suggests that these data are generalizable across the spectrum of acute care facilities. Although the magnitude of the odds of death after multivariate analysis was lower than has been reported in previous studies (7–9), this study also provides further evidence of AKI as an independent mortality risk.

The results of this study must be viewed in light of the limitations of its methodology, specifically reliance on administrative ICD-9-CM coding for identification of AKI. To validate this approach, the authors compared ICD-9-CM coding of AKI to an audit of serum creatinine values for all patients who were discharged from their tertiary care medical center, using the criteria of Hou et al. (1). Although the specificity of the ICD-9-CM coding for AKI was 99.6%, the sensitivity was only 19.2%. These results, which are similar to other reported analyses of ICD-9 coding of AKI (10), suggest that administrative ICD-9 coding substantially underreports the true incidence of AKI. Thus, rather than 550,000 cases annually, the actual number of cases of AKI in the United States may be as high as 2 to 3 million patients per year. One might speculate, however, that there is bias in coding and that the cases that were missed on the basis of ICD-9 codes are the “less” severe episodes of AKI. Thus, although this study may have identified only the tip of the iceberg, some might suggest that the cases that are hidden beneath the waterline reflect only mild acute renal insufficiency and are of only lesser importance.

In fact, recent studies have suggested that even minimal increases in serum creatinine are associated with substantial increases in mortality, hospital length of stay, and cost. In a sample of nearly 20,000 consecutive patients who were admitted to a single academic medical center, Chertow et al. (11) observed that increases in serum creatinine of ≥0.5 mg/dl, which were present in 13% of patients, were associated after multivariate adjustment for demographic factors and comorbid disease with a 6.5-fold increased odds of death. Even lesser elevations in serum creatinine were associated with increased mortality risk, with a 70% increase in adjusted mortality risk associated with increases in serum creatinine of only 0.3 to 0.4 mg/dl.

Although the article by Liangos et al. is an important addition to our understanding of the epidemiology of AKI, there is still much more to be learned. First and foremost, there needs to be a consensus on criteria to define AKI. The RIFLE criteria (12), proposed by the ad hoc Acute Dialysis Quality Initiative, which stratifies AKI into levels of graded severity on the basis of increments in serum creatinine or the duration of oliguria, are a first step but will require validation and refinement. Ultimately, more specific and sensitive indices of renal injury, including biomarkers that precede observable changes in renal function, will be required for a robust definition of AKI that allows rapid and accurate diagnosis.

It is doubtful that we will ever have an epidemiologic surveillance system for AKI comparable to that provided by the United States Renal Data System for ESRD. Although the precision with which this study describes the epidemiology of AKI is imperfect, it adds to the growing evidence that AKI is a major public health burden, taking its toll in morbidity, mortality, and cost, and justifies the call by the American Society of Nephrology and other societies for additional research support to ultimately provide more effective preventive and therapeutic interventions.

References