Trends in In-Hospital Cardiopulmonary Resuscitation and Survival in Adults Receiving Maintenance Dialysis

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IMPORTANCE Understanding cardiopulmonary resuscitation (CPR) practices and outcomes can help to support advance care planning in patients receiving maintenance dialysis.

OBJECTIVE To characterize patterns and outcomes of in-hospital CPR in US adults receiving maintenance dialysis.

DESIGN, SETTING, AND PARTICIPANTS This national retrospective cohort study studied 663,734 Medicare beneficiaries 18 years or older from a comprehensive national registry for end-stage renal disease who initiated maintenance dialysis from January 1, 2000, through December 31, 2010.

EXPOSURES Receipt of in-hospital CPR from 91 days after dialysis initiation through the time of death, first kidney transplantation, or end of follow-up on December 31, 2011.

MAIN OUTCOMES AND MEASURES Incidence of CPR and survival after the first episode of CPR recorded in Medicare claims during follow-up.

RESULTS The annual incidence of CPR for the overall cohort was 1.4 events per 1000 in-hospital days (95% CI, 1.3-1.4). A total of 21.9% CPR recipients (95% CI, 21.4%-22.3%) survived to hospital discharge, with a median postdischarge survival of 5.0 months (interquartile range, 0.7-16.8 months). Among patients who died in the hospital, 14.9% (95% CI, 14.8%-15.1%) received CPR during their terminal admission. From 2000 to 2011, there was an increase in the incidence of CPR (1.0 events per 1000 in-hospital days; 95% CI, 0.9-1.1; to 1.6 events per 1000 in-hospital days; 95% CI, 1.6-1.7; P for trend <.001), the proportion of CPR recipients who survived to discharge (15.2%; 95% CI, 11.1%-20.5%; to 28%; 95% CI, 26.7%-29.4%; P for trend <.001), and the proportion of in-hospital deaths preceded by CPR (9.5%; 95% CI, 8.4%-10.8%; to 19.8%; 95% CI, 19.2%-20.4%; P for trend <.001), with no substantial change in duration of postdischarge survival.

CONCLUSIONS AND RELEVANCE Among a national cohort of patients receiving maintenance dialysis, the incidence of CPR was higher and long-term survival worse than reported for other populations.

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In recent decades, use of in-hospital cardiopulmonary resuscitation (CPR) has been increasing, and there has been a gradual shift toward increased use in sicker patients. A growing number of patients now survive an episode of CPR but often subsequently face substantial disability. Advanced age and comorbidity are compounding factors associated with higher mortality, greater neurologic and nonneurologic impairment, and functional dependence after CPR.

There is a paucity of published data on CPR outcomes among patients receiving maintenance dialysis. Most previous studies have been limited to cardiac arrests occurring in outpatient hemodialysis units. Rates of survival to hospital discharge across these studies have varied widely from 0% to 24.0%. Only one prior study has examined outcomes after in-hospital CPR among patients receiving dialysis. This single-center study reported very low rates of survival to hospital discharge (8.0%) and significant disability after an episode of in-hospital CPR in this population. To our knowledge, no prior studies have defined the incidence and outcomes of in-hospital CPR among a national cohort of patients receiving dialysis.

Methods

Data Sources

We designed a study to define the incidence and outcomes of CPR among a national cohort of US patients receiving dialysis using data from the US Renal Data System (USRDS) registry, a comprehensive national data system that collects, analyzes, and distributes information about end-stage renal disease (ESRD) in the United States. The USRDS is funded by the National Institute of Diabetes and Digestive and Kidney Diseases and collaborates with the Centers for Medicare & Medicaid Services (CMS) to prospectively gather demographic and clinical information on all US patients treated with maintenance dialysis. As mandated by the CMS, patients are enrolled in the USRDS registry after the onset of ESRD. Information on patients is collected using standardized forms completed by the nephrologist around the time of ESRD onset (CMS-2728 form) and shortly after death (CMS-2746 form). Patients who are not eligible for Medicare at the time of ESRD become eligible by reason of their ESRD. The USRDS provides linked Medicare claims for patients in the registry. Data distributed by USRDS are deidentified.

Study Population

Using data from the USRDS registry, we identified all patients 18 years or older without a prior kidney transplant who initiated maintenance dialysis from January 1, 2000, through December 31, 2010 (Figure 1). We limited our study to those with Medicare Parts A and B as the primary payer for health care from 91 days after dialysis initiation through to death, first kidney transplantation, or end of follow-up on December 31, 2011. Patients who received a kidney transplant or died within 90 days of dialysis initiation were excluded from the analy-
The final analytic cohort comprised 663,734 patients. Mean (SD) follow-up for the overall cohort was 2.9 (2.5) years. This study was approved by the institutional review board at the University of Washington.

**Primary Outcome Measures**
From the linked Medicare claims, we ascertained all hospital admissions and all in-hospital CPR events that occurred beyond 90 days after dialysis initiation using *International Classification of Diseases, Ninth Revision (ICD-9)* diagnostic codes 99.60 and 99.63.17 Multiple CPR events that occurred during the same admission were counted as separate events if they occurred at least one calendar day apart. The CPR events that occurred in the emergency department were excluded. We calculated the incidence of in-hospital CPR as the total number of in-hospital CPR events per 1000 in-hospital days during follow-up. Multiple CPR events in the same patient contributed to incidence estimates. We also measured the proportion of patients surviving to hospital discharge after their first in-hospital CPR event. We measured median survival after discharge using the Kaplan-Meier method among members of this subgroup. Among cohort patients who died in the hospital at any time during follow-up, we measured the proportion who received CPR during their terminal hospitalization. The CPR incidence, the proportion of CPR recipients who survived to hospital discharge, postdischarge survival, and receipt of CPR before in-hospital death were reported for the overall cohort and over time.

**Patient Characteristics**
From the USRDS Patients File (CMS-2728 form) and Medical Evidence File (CMS-2846 form), we obtained the following patient characteristics at the time of dialysis initiation: sex, race, age, listed cause of ESRD, calendar year of dialysis initiation, dialysis modality, and the comorbidities coronary artery disease, peripheral vascular disease, congestive heart failure, hypertension, diabetes mellitus, stroke, cancer, and chronic obstructive pulmonary disease. For patients who received CPR, we used these sources in combination with Medicare claims for CPR events to calculate each patient’s age at the time of their initial CPR event. For cohort patients who died in the hospital during follow-up, we calculated their age at the time of death and obtained information on cause of death from the Patients File.

**Statistical Analysis**
We described the characteristics of patients who received at least one episode of in-hospital CPR and those of CPR recipients who survived to discharge after their first episode of in-hospital CPR using point estimates and 95% CIs (Table 1). Incidence rate ratios of CPR were calculated using Poisson regression models to compare rates across different groups of patients. These models were adjusted for age, sex, race, cause of ESRD, comorbidities, dialysis modality, and calendar year of dialysis initiation. For those who received CPR, we used multivariable logistic regression analysis to examine patient characteristics associated with survival to discharge. These analyses were adjusted for sex, race, cause of ESRD, comorbidities and dialysis modality documented at the time of dialysis initiation, and age and calendar year in which the index CPR event occurred. For CPR recipients who survived to discharge, risk of death after hospital discharge was measured using a Cox proportional hazards regression model adjusted for sex, race, cause of ESRD, comorbidities and dialysis modality documented at the time of dialysis initiation, and age and calendar year in which the index CPR event occurred. To examine patient characteristics associated with receipt of CPR before death among patients who died in the hospital, we used multivariate logistic regression models that controlled for sex, race, cause of ESRD, comorbidities and dialysis modality documented at the time of dialysis initiation, and age and calendar year at the time of death.

To facilitate comparisons with previously published studies in other populations that have measured CPR incidence as a function of the number of hospital admissions rather than the number of inpatient days and that have included only older adults, we conducted additional analyses to estimate the total number of in-hospital CPR events per 1000 hospital admissions and repeated the primary analyses after stratification by age group (<65 and ≥65 years).

Statistical packages used included SAS statistical software, version 9 (SAS Institute Inc), and SPSS statistical software, version 19 (SPSS Inc).

**Results**

**CPR Events**
Overall, 80.9% (95% CI, 80.8%-81.0%) of patients in the study cohort were admitted to the hospital at least once during follow-up. Of these, 6.3% (95% CI, 6.2%-6.4%) underwent at least one episode of CPR while hospitalized. Among patients who underwent CPR, 4.4% (95% CI, 4.2%-4.6%) received CPR more than once during follow-up. The annual incidence of in-hospital CPR for the entire cohort was 1.4 (95% CI, 1.3%-1.4%) per 1000 in-hospital days. The incidence of CPR was higher among men vs women, black vs white patients, patients younger than 65 years vs those 65 years or older, those whose cause of ESRD was listed as hypertension or diabetes mellitus vs other causes, and those with vs without coronary artery disease, congestive heart failure, hypertension, and diabetes mellitus (eTable 1 in the Supplement).

**Survival to Hospital Discharge**
The proportion of CPR recipients surviving to hospital discharge was 21.9% (95% CI, 21.4%-22.3%). The proportion surviving to discharge was greater among women vs men, white vs black patients, those younger than 65 years vs those 65 years or older, those whose listed cause of ESRD was due to diabetes mellitus, and those who were treated with hemodialysis vs peritoneal dialysis (eTable 2 in the Supplement). The median length of hospital stay after the index CPR event for patients who survived to discharge was 8.0 days (interquartile range [IQR], 3.0-14.0 days).
Postdischarge Survival
Among those alive at discharge, median survival from the time of discharge was 5.0 months (IQR, 0.7-16.8 months). The proportion of patients who survived to 1 year after discharge was 31.3% (95% CI, 30.3%-32.4%). Most patients (66.3%; 95% CI, 65.2%-67.4%) were hospitalized again at least once during follow-up. For CPR recipients who survived to discharge and died during follow-up, cardiovascular causes were reported as the primary or secondary cause of death for 43.0% (95% CI, 41.9%-44.1%) of patients. Survival after discharge was more limited among men vs women, white vs black patients, those 65 years or older vs younger than 65 years, and patients with vs without coronary artery disease, hypertension, diabetes mellitus, and cancer (eTable 3 in the Supplement).

In-Hospital Deaths Occurring After CPR
Among cohort members who died in the hospital during follow-up, 14.9% (95% CI, 14.8%-15.1%) had received at least one episode of CPR during the terminal hospitalization. The subset of patients who received CPR during the terminal admission were more likely to be men vs women, black vs white, and those 65 years or older vs younger than 65 years (eTable 4 in the Supplement).

Trends in CPR Practice and Outcomes
From 2000 through 2011 the incidence of CPR increased from 1.0 (95% CI, 0.9-1.1) to 1.6 (95% CI, 1.6-1.7) events per 1000 in-hospital days (P for trend <.001) (Figure 2). The percentage of CPR recipients surviving to discharge increased from 15.2% (95% CI, 11.1%-20.5%) to 28.0% (95% CI, 26.7%-29.4%) (P for trend <.001) (Figure 3). Slight variations in duration of postdischarge survival resulted in a small but statistically significant uptrend in postdischarge survival over time (P for trend <.001), although the median survival after hospital discharge was 6.5 months (IQR, 2.7-26.7 months) in 2000 and 5.9 months (IQR, 1.7-17.9 months) in 2011 (Figure 3). Among CPR recipients who survived to discharge, median length of hospital stay after the initial CPR event did not change (8.5 days; IQR, 4.0-20.3 days; to 8.0 days; IQR, 4.0-14.0 days; P for trend = .70) over time. The proportion of in-hospital deaths preceded by CPR increased

Table 1. Characteristics of Patients Who Received In-Hospital CPR

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>No. (%) of Patients</th>
<th>Survived to Discharge, % (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total patients</td>
<td>663 734</td>
<td>33 731</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>362 392 (54.6)</td>
<td>18 174 (53.9)</td>
</tr>
<tr>
<td>Female</td>
<td>301 340 (45.4)</td>
<td>15 557 (46.1)</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>433 653 (65.3)</td>
<td>19 531 (57.9)</td>
</tr>
<tr>
<td>Black</td>
<td>191 520 (28.9)</td>
<td>12 381 (36.7)</td>
</tr>
<tr>
<td>Other</td>
<td>34 071 (5.1)</td>
<td>1598 (4.7)</td>
</tr>
<tr>
<td>Age at CPR event, y</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;65</td>
<td>282 667 (42.6)</td>
<td>15 359 (45.5)</td>
</tr>
<tr>
<td>≥65</td>
<td>381 067 (57.4)</td>
<td>18 375 (54.5)</td>
</tr>
<tr>
<td>Cause of end-stage renal disease</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hypertension</td>
<td>183 168 (27.6)</td>
<td>8838 (26.2)</td>
</tr>
<tr>
<td>Acute tubular necrosis</td>
<td>15 395 (2.3)</td>
<td>517 (1.5)</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>307 921 (46.4)</td>
<td>18 330 (54.3)</td>
</tr>
<tr>
<td>Glomerulonephritis</td>
<td>52 986 (8.0)</td>
<td>1994 (5.9)</td>
</tr>
<tr>
<td>Other</td>
<td>75 195 (11.3)</td>
<td>2946 (8.7)</td>
</tr>
<tr>
<td>Unknown</td>
<td>29 069 (4.4)</td>
<td>1106 (3.3)</td>
</tr>
<tr>
<td>Modality</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hemodialysis</td>
<td>621 189 (93.6)</td>
<td>31 870 (94.5)</td>
</tr>
<tr>
<td>Peritoneal dialysis</td>
<td>42 545 (6.4)</td>
<td>1861 (5.5)</td>
</tr>
<tr>
<td>Comorbidities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coronary artery disease</td>
<td>80 204 (12.1)</td>
<td>5647 (16.7)</td>
</tr>
<tr>
<td>Peripheral arterial disease</td>
<td>47 964 (7.2)</td>
<td>3289 (9.8)</td>
</tr>
<tr>
<td>Congestive heart failure</td>
<td>102 689 (15.5)</td>
<td>7579 (22.5)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>228 602 (34.4)</td>
<td>16 318 (48.4)</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>150 405 (22.7)</td>
<td>11 920 (35.3)</td>
</tr>
<tr>
<td>Stroke</td>
<td>29 673 (4.5)</td>
<td>1924 (5.7)</td>
</tr>
<tr>
<td>Chronic obstructive pulmonary disease</td>
<td>25 650 (3.9)</td>
<td>1704 (5.1)</td>
</tr>
<tr>
<td>Cancer</td>
<td>18 645 (2.8)</td>
<td>937 (2.8)</td>
</tr>
</tbody>
</table>

Abbreviation: CPR, cardiopulmonary resuscitation.
from 9.5% (95% CI, 8.4%-10.8%) to 19.8% (95% CI, 19.2%-20.4%) (P for trend <.001) (eFigure in the Supplement).

Discussion

To our knowledge, this is the first study to report national rates of in-hospital CPR use and outcomes among Medicare beneficiaries receiving maintenance dialysis. Rates of in-hospital CPR among members of this cohort were very high and survival beyond hospital discharge substantially worse than reported previously for other populations (Table 2).1-3,19,20

In-hospital CPR use was 20 times more common among members of this cohort compared with a nationally representative sample of the general population (6.3% vs 0.3%).2 Although the proportion of CPR recipients in this cohort surviving to hospital discharge (21.9%) was comparable to that reported for other hospitalized patients (17.0% to 23.0%),2,18 median survival after discharge was considerably worse. Members of this cohort survived a median of 5 months after hospital discharge compared with almost 3 years for other hospitalized patients.19 Differences with prior reports in other populations were even more striking after accounting for differences in age. Compared with older Medicare beneficiaries,17 in-hospital CPR was more common and postdischarge survival after an episode of CPR more limited for both younger (<65 years old) and older (≥65 years old) members of this cohort (Table 2). These results likely reflect a number of different factors for patients receiving maintenance dialysis, including more limited life expectancy, higher rates of cardiac arrest and cardiovascular-related comorbid conditions,14,21-24 and more frequent receipt of interventions intended to prolong life compared with the general population.25

From 2000 through 2011, there was a small increase in overall rates of in-hospital CPR among members of this cohort. This trend is similar to that reported among the wider population of older Medicare beneficiaries17 and for the general inpatient population among whom there was an increase in rates of in-hospital CPR from 0.87 to 0.99 CPR events per 1000 in-hospital days during a similar period.1 Reasons for an increase in the rates of in-hospital CPR are not clear, but the increase coincides with increases in the rates of hospital and intensive care unit admissions and the use of mechanical ventilation near the end of life among the wider population of Medicare beneficiaries, suggesting broad trends toward more intensive patterns of care during this same period.26

We also found an increase in the percentage of patients surviving to discharge after the initial CPR event. This upward trend in rates of hospital survival coincides with similar increases reported in the general population during this time frame, which has been attributed in part to advancements in resuscitation care.8,18 This increase might also be a reflection of concurrent changes in hospital discharge practices re-
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Original Investigation Research

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ported in the general and wider Medicare populations and increasing use of hospice and long-term care facilities after an episode of in-hospital CPR during which patients might subsequently die.\(^3\)\(^-\)\(^7\) It seems less likely that improvements in survival to discharge may reflect more selective use of CPR in this population given the upward trend in the incidence of CPR and the proportion of in-hospital deaths preceded by CPR during the same time frame. Despite improvements in survival to discharge among members of this cohort, gains in postdischarge survival during the same time frame were minimal, likely reflecting the underlying frailty and limited life expectancy of patients receiving maintenance dialysis. The life expectancy of a patient after initiation of maintenance dialysis is approximately a quarter of that reported for a person of similar age in the general population.\(^\text{24}\)

Although survival after an episode of CPR was generally poor, there were some differences in outcomes across patient subgroups. Not surprisingly, survival to hospital discharge was lower and median postdischarge survival more limited among members of our cohort with other significant comorbid illness, such as coronary artery disease (17.3% and 4.0 months, respectively), congestive heart failure (18.0% and 4.7 months, respectively), chronic obstructive pulmonary disease (17.2% and 4.0 months, respectively), and cancer (17.2% and 2.6 months, respectively). In contrast with a previous report\(^\text{29}\) in the general population that found survival after an episode of CPR to be better among white than black patients, duration of postdischarge survival after an episode of CPR was slightly longer among black patients receiving maintenance dialysis compared with their white counterparts (6.1 vs 5.4 months), finding consistent with a robust body of literature reporting longer survival after dialysis initiation among black patients, which has been variously attributed to racial differences in burden of comorbidity,\(^27\) access to kidney transplant and competing risk of death during the advanced stages of kidney disease,\(^28\) and biological responses to dialysis.\(^\text{30}\) We found that patients receiving peritoneal dialysis experienced fewer CPR events compared with those receiving hemodialysis (1.2 vs 1.4 events per 1000 in-hospital days), which is consistent with a prior USRDS report\(^\text{24}\) indicating lower rates of cardiovascular-related events among patients receiving peritoneal dialysis vs hemodialysis; however, outcomes after CPR were comparable for both groups.

Collectively, our findings signal a need and an opportunity to enhance advance care planning in this population.\(^\text{30}\) Information on population-level outcomes after CPR may be useful background for supporting discussions among patients, families, and health care professionals about desired treatment intensity and preferences for resuscitation. Prior studies\(^31\)\(^-\)\(^33\) indicate that many patients receiving dialysis have unrealistic expectations about CPR outcomes. Caution should be exercised in interpreting the modest improvement in survival to discharge after an episode of CPR over time to encourage increased CPR use in light of the persistently poor postdischarge survival among CPR recipients in this cohort. Available data in the general population suggest that when physicians share more accurate information about CPR, many patients elect not to receive CPR.\(^\text{34}\) Most patients receiving dialysis have not completed an advance directive or shared their end-of-life care preferences with their physicians,\(^\text{35}\)\(^-\)\(^36\) and patients are more likely to receive aggressive care when they do not have treatment-limiting directives in place.\(^37\)\(^-\)\(^38\) Facilitated disease-specific approaches to advance care planning, including patients receiving maintenance dialysis, can lead to greater concordance between a patient’s treatment preferences and care received at the end of life and more positive assessment from family members of patient/physician interactions around the time of death.\(^39\)\(^-\)\(^42\)

Our study was strengthened by the inclusion of a nationally representative population of patients receiving maintenance dialysis and by comprehensive and uniform ascertainment of in-hospital CPR events. Nonetheless, several limitations of our study merit consideration. First, although we used a previously published approach to case finding,\(^27\) the sensitivity and specificity of administrative codes for CPR from Medicare claims have not been validated. Studies of CPR in other populations have used a variety of strategies to identify CPR events through administrative claims,\(^2\)\(^9\)\(^-\)\(^26\) use of registry data,\(^1\)\(^18\)\(^-\)\(^20\) and medical record review,\(^19\) which might account for some of the differences we observed in CPR practices and outcomes between patients receiving maintenance dialysis and studies conducted in other populations. Several reports have used data from the American Heart Association’s Get with the Guidelines Resuscitation Registry,\(^1\)\(^18\)\(^-\)\(^20\) a national quality improvement registry constructed from information collected prospectively by trained personnel using standardized definitions of cardiac arrest and CPR.\(^\text{53}\)\(^-\)\(^\text{44}\) Although this approach allows for careful characterization and ascertainment of cases from participating hospitals engaged in quality improvement, an advantage of using administrative claims is that we were able to capture CPR events occurring across a range of inpatient settings among members of this cohort.

Second, we do not have information on several factors that might affect survival after CPR, including details of the cardiac arrest event, such as initial cardiac arrest rhythm, treatments used during and after resuscitation, and in-hospital location of the arrest, and hospital-level characteristics, such as the number of CPR events handled at each facility per year and whether the arrest was attended by a designated resuscitation (code) team.\(^\text{21}\)

Third, we do not have details on more patient-centered outcomes, such as level of disability, hospice referral, and nursing home use after CPR.

Fourth, our results may be limited by the accuracy of the information on comorbidities ascertained at the time of dialysis initiation reported on the CMS-2728 form,\(^\text{45}\) which might not entirely capture comorbidities and level of illness severity around the time of cardiac arrest.

Conclusions

The incidence of in-hospital CPR among patients receiving dialysis is high despite poor long-term survival after an episode of CPR. These findings support the relevance of advance care planning and setting realistic expectations regarding resuscitation treatment in this population.
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Disclaimer: This work was conducted at the University of Washington and does not represent the opinion of the United States Renal Data System.

REFERENCES
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Original Investigation Research

Invited Commentary

Dialysis Plus Do Not Resuscitate—Not a Contradiction

Emilee R. Wilhelm-Leen, MD; Glenn M. Chertow, MD, MPH

More than 400,000 persons in the United States are currently receiving maintenance dialysis as life-sustaining treatment for end-stage renal disease (ESRD), with more than 90% receiving in-center hemodialysis. Mortality rates in the ESRD population in the United States remain extremely high (18%-20% per year) despite a slight downward trend during the past 2 to 3 years. Most deaths among patients with ESRD are due to cardiovascular disease, with exceptionally high rates, particularly on an age-adjusted basis, of heart failure, stroke, and sudden death. In fact, sudden death accounts for roughly 1 in 4 deaths among patients receiving dialysis.1

Several factors have been blamed for the high rates of sudden death in ESRD, including arrhythmias associated with altered left ventricular architecture, calcification of the cardiac conduction system, obstructive and central sleep apnea, inflammation, autonomic neuropathy, electrolyte abnormalities associated with impaired kidney function (eg, hyperkalemia often exacerbated by hyperglycemia and/or metabolic acidosis), and abnormalities associated with rapid shifting of electrolytes during the hemodialysis procedure (eg, hypokalemia and hypocalcemia).2 Research aimed at identifying modifiable risk factors for sudden death have largely focused on cardiac arrest associated with the hemodialysis procedure; observational data have suggested that hemodialysis using very low dialysate (bath) concentrations of potassium (0 or 1 mEq/L) is associated with higher rates of in-center cardiac arrest compared with hemodialysis using higher dialysate potassium concentrations.3 Relatively little research, in contrast, has focused on in-hospital cardiac arrest, and accurate estimation of risk and prognosis in this setting is needed.

In this issue of JAMA Internal Medicine, Wong et al4 report correlates and consequences of cardiopulmonary resuscitation (CPR) in hospitalized patients with ESRD. They found extremely high overall rates of CPR (6.3% of all hospitalized patients, corresponding to 1.4 events per 1000 in-hospital days) with a trend toward higher rates of CPR in more recent years. Cardiopulmonary resuscitation rates were higher among younger patients, men, blacks, and patients with hypertension, diabetes mellitus, and, as expected, a history of coronary artery disease or heart failure. As rates of CPR among patients with ESRD have increased, so too has the proportion of patients with ESRD undergoing CPR who survived to hospital discharge. However, median survival after hospital discharge was only 5 months, with more than 1 in 4 patients dying within 30 days. In comparison, in an analysis from the Nationwide Inpatient Sample using data from 2000 to 2009, Chen et al5 reported an overall rate of CPR of 4.54 per 1000 admissions; survival to hospital discharge was 19.2%, suggesting that the rates of CPR among patients with ESRD are more than 10-fold higher, whereas survival to hospital discharge is roughly similar to the general population. Unfortunately, postdischarge survival is markedly lower among patients with ESRD.

Wong et al appropriately view these findings as an opportunity (arguably a responsibility) to enhance advance care planning in ESRD; indeed, these discussions may be occurring far less frequently than we might hope. Davison6 found that less than 10% of patients in a single Canadian dialysis center could recall discussing end-of-life wishes with their nephrologist in the preceding year. Kurella Tamura et al7 found that 57% of patients from 2 US dialysis facilities reported having an end-of-life discussion with a health care professional, 38% had completed an advance directive, and 10% had a do-not-resuscitate or do-not-intubate order in their dialysis facility records, despite a well-established infrastructure within all US dialysis centers to discuss issues and document preferences related to advance care planning—a multidisciplinary care team consisting of physicians, nurses, technicians, dietitians, and social workers.

Relative to most patients with other chronic diseases, there are ample opportunities for advance care planning in the dialysis setting. Patients are generally seen by dialysis unit staff