Kidney Medicine

Kidney Function Trajectories and Health Care Costs: Identifying High-Need, High-Cost Patients

Chi D. Chu, Delphine S. Tuot, and Sri Lekha Tummalapalli

The wide spectrum of risk associated with chronic kidney disease (CKD) is a fundamental challenge in delivering timely, high quality CKD care. Although many patients with CKD experience stable long-term kidney function, others experience rapid decline in kidney function and progression toward kidney failure along with other risks associated with advanced CKD (eg, cardiovascular disease).[1] Complications in progressive CKD have substantial implications for costs of care: Medicare expenditures per beneficiary with CKD G4/G5 are 40% higher than those per beneficiary with CKD G3.[2] Given the high prevalence of CKD, risk stratification is essential for directing and optimizing care for those at the greatest risk of adverse outcomes, potentially forestalling disease progression and mitigating costs associated with progressive CKD.

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Risk stratification for CKD traditionally comprises risk categories defined by static measures of estimated glomerular filtration rate (eGFR) and urinary albumin-creatinine ratio values.[3] Additional risk stratification tools have been developed, such as the Kidney Failure Risk Equation and models from the CKD Prognosis Consortium.[4–7] The Kidney Failure Risk Equation is associated with health care costs for patients with an eGFR <60 mL/min/1.73 m^2, but the association of earlier stage kidney function with costs is less clear.[8] To date, risk stratification tools have largely been based on one-time measures of predictors and have not incorporated longitudinal predictors, such as the slope or trajectory of eGFR over time. In part, this may be because prior attempts to add time-dependent data to prediction models have led to only modest improvements in predictive performance.[9,10] Nevertheless, the historical trajectory of eGFR remains a prominent consideration for risk stratification, particularly because other key predictors (eg, albuminuria) are often unavailable.

In this issue of *Kidney Medicine*, Diamantidis and colleagues[11] sought to examine the association between the trajectory of eGFR and annual health care costs in a cohort of Medicare Advantage enrollees. They used linked claims and laboratory data from the OptumLabs Data Warehouse, allowing the authors to characterize eGFR trajectories as well as ascertain actual costs incurred by the health plan and the enrollee. Entry criteria for the study cohort required consecutive values of eGFR 60-89 mL/min/1.73 m^2 at least 3 months apart. The authors applied group-based trajectory modeling to categorize eGFR trends during follow-up. Among 421,187 enrollees over a median 2.6 year follow-up, this approach identified 5 distinct trajectories: 22.3% had stable eGFR; 30.2% had slow decline starting from ~79 mL/min/1.73 m^2; 28.4% had slow decline starting from ~71 mL/min/1.73 m^2; 16.3% had steep decline (loss of ~7 mL/min/1.73 m^2 per year over the first year); and 2.8% had accelerated decline (loss of ~15 mL/min/1.73 m^2 per year over the first year). The authors found that total annual health care costs were consistently nearly double for the accelerated decline group compared with all the other groups ($22-28,000/year vs $10-15,000/year), even in the year preceding cohort entry (before observed eGFR decline). The authors conclude that these results underscore the critical importance of early CKD identification and risk stratification as a potential means to mitigate downstream costs and comorbid conditions associated with rapid decline. Additional research could elucidate whether historical eGFR trajectories are predictive of future costs and whether eGFR trajectories are associated with costs independent of other clinical comorbid conditions. Strengths of this study include the use of a large, national data source containing both laboratory data for ascertaining eGFR trajectories as well as comprehensive cost data to capture amounts actually paid by patients and health plans.

Although 5 patterns of eGFR trajectories were identified in this study, the groups were not evenly sized. Indeed, the fastest progressing group ("accelerated decline") only constituted 2.8% of the study population, whereas >80% of the population was in groups with stable or more slowly declining eGFR. This finding underscores the tremendous heterogeneity of progression risk in CKD, a reality that poses a formidable barrier to optimal resource allocation for clinicians, health systems, and payers. Effective risk stratification is therefore vital for identifying and focusing intensively on the small number of patients at marked risk of accelerated CKD progression while reassuring the majority of patients whose CKD will remain stable or progress minimally over the long term.

In early or mild CKD, a number of tools have been developed for predicting the risk of incident eGFR <60 mL/min/1.73 m^2 or 40% eGFR decline.[6,7] Interestingly, in this study, the descriptive characteristics suggest that higher risk CKD can be clinically discerned even before a declining eGFR trajectory occurs. At baseline, the accelerated decline group was several-fold more likely to have had an outpatient nephrologist visit (6.5% vs 3.4% for the steep decline group and <2% for all the others). Having a diagnosis of CKD was also more common: 23.7% in the accelerated group vs 15.2% in the steep decline

group and <8% in all other groups. These data suggest that clinicians are recognizing patients at risk for CKD progression, although this study did not have data to suggest how these patients are being identified—whether by albuminuria testing or through recognition of other risk factors denoting a sicker population. The accelerated decline group had more hypertension, more diabetes, and higher Charlson comorbidity scores compared with the other groups. Thus, the finding that the accelerated eGFR decline group incurred significantly greater health care costs than its slower-progressing counterparts even before eGFR decline was not surprising because it clearly represents a sicker population. It may also suggest that high historical costs could be used to identify the elevated risk of CKD progression and as a predictor of high future health care cost.

Diamantidis and colleagues' analysis opens several future areas of inquiry. First, prediction models are needed to identify the small subgroup of patients likely to have accelerated decline who may be at the greatest risk of kidney and cardiovascular complications. These patients may need more frequent monitoring to adjust medication dosing, avoid electrolyte abnormalities, and ensure appropriate guideline-directed medical therapy. Existing prediction models could potentially be modified to identify those with accelerated eGFR decline.[6,12] Notably, 89.6% of the cohort studied by Diamantidis and colleagues were missing albuminuria testing, which poses a major barrier for implementing existing risk prediction tools, especially for population-level interventions. Predicting accelerated decline could allow health systems and payers to offer more intensive population health strategies to individuals at high risk of progression, in addition to the CKD G4/G5 population.

Second, further exploration could uncover the drivers of higher health care costs in the "accelerated decline" group. Examining reasons for hospitalizations could show whether costs were related to CKD or associated comorbid conditions, such as diabetes, heart failure, or other cardiovascular conditions. This information could inform targeted interventions to lower acute care utilization and address potentially preventable spending. Medicare Advantage plans are particularly interested in predicting "high-need, high-cost" patients and intervening to reduce their total costs of care.[13] Similarly, nephrology practices in the Comprehensive Kidney Care Contracting model are incentivized to reduce total costs of care for patients with CKD G4/G5. Both Medicare Advantage plans and Comprehensive Kidney Care Contracting participants are now partnering with value-based kidney care companies that frequently employ proprietary risk models to predict health care utilization and costs.[14,15] The scale of these programs is immense: nearly half (48%) of Medicare beneficiaries are now enrolled in Medicare Advantage, and over 65,000 patients with CKD are aligned to the Comprehensive Kidney Care Contracting model.[16] Predicting the costs of care and drivers of those costs will become increasingly important in a value-based environment.[17]

Third, after predicting high-cost patients with accelerated eGFR decline, interventions must be prospectively tested to improve clinical outcomes and reduce costs in this population. Interventions targeting high-need, high-cost patients in primary care and emergency department settings have shown effectiveness in reducing hospitalizations and health care costs.[18] Similar interventions including care management, registries and outreach, patient navigators, and e-consultation are being tailored toward patients with CKD.[19] Future trials could be enriched for high-cost patients with accelerated eGFR decline. Improved identification of high-need, high-cost patients is critical to ensure that high-intensity multidisciplinary interventions are targeted appropriately; if applied too broadly, these interventions would risk increasing overall costs. Robust evaluation of interventions using randomized controlled trials is critical because many patients identified as high-need, high-cost will have "regression to the mean" and be less costly in the future. Hence, observational studies frequently overestimate cost savings when examining cost trends over time.[20] Ultimately, cost considerations must be balanced with patient-centered outcomes because many health care interventions are worthwhile even if they are not cost saving by improving health care outcomes at a reasonable cost (ie, cost-effectiveness).

In summary, Diamantidis and colleagues' analysis highlights the clinical heterogeneity in CKD and the potential to identify subgroups with disproportionate spending that are critical to intervene. Altering the clinical and economic trajectory of these patients will be a challenging task. As health systems and payers invest in population health management for individuals with CKD and other chronic conditions, effectively risk stratifying patients will prove crucial to increase health care value.

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