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ORIGINAL ARTICLE

Development and Validation of Prediction Scores for Early Mortality at Transition to Dialysis

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Abstract

Objective: To develop and validate a risk prediction model that would help individualize treatment and improve the shared decision-making process between clinicians and patients.

Patients and Methods: We developed a risk prediction tool for mortality during the first year of dialysis based on pre–end-stage renal disease characteristics in a cohort of 35,878 US veterans with incident end-stage renal disease who transitioned to dialysis treatment between October 1, 2007, and March 31, 2014 and then externally validated this tool among 4284 patients in the Kaiser Permanente Southern California (KPSC) health care system who transitioned to dialysis treatment between January 1, 2007, and September 30, 2015.

Results: To ensure model goodness of fit, 2 separate models were selected for patients whose last estimated glomerular filtration rate (eGFR) before dialysis initiation was less than 15 mL/min per 1.73 m^2 or 15 mL/min per 1.73 m^2 or higher. Model discrimination in the internal validation cohort of veterans resulted in C statistics of 0.71 (95% CI, 0.70-0.72) and 0.66 (95% CI, 0.65-0.67) among patients with eGFR lower than 15 mL/min per 1.73 m^2 and 15 mL/min per 1.73 m^2 or higher, respectively. In the KPSC external validation cohort, the developed risk score exhibited C statistics of 0.77 (95% CI, 0.74-0.79) in men and 0.74 (95% CI, 0.71-0.76) in women with eGFR lower than 15 mL/min per 1.73 m^2 and 0.71 (95% CI, 0.67-0.74) in men and 0.67 (95% CI, 0.62-0.72) in women with eGFR of 15 mL/min per 1.73 m^2 or higher.

Conclusion: A new risk prediction tool for mortality during the first year after transition to dialysis (available at www.DialysisScore.com) was developed in the large national Veterans Affairs cohort and validated with good performance in the racially, ethnically, and gender diverse KPSC cohort. This risk prediction tool will help identify high-risk populations and guide management strategies at the transition to dialysis.

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The number of incident cases of end-stage renal disease (ESRD) in the United States has risen over time and exceeded 120,000 in 2014.[1] There is substantial heterogeneity in the incident ESRD population in which some patients may die early after dialysis initiation while others may experience greater longevity with dialysis. Overall, mortality is exceptionally high during the first year of dialysis.[1]

Plans for the initiation of maintenance dialysis therapy, including whether to initiate dialysis, integrate conservative care, or organize end-of-life support, are affected by various factors such as comorbid conditions, personal beliefs, and cultural perspectives.[2,3] A risk prediction model to predict early mortality could help individualize treatment and support the shared decision-making process among clinicians, patients, and patients' family members. For example, if a patient has high anticipated risk of mortality within 1 year of dialysis, conservative management with infrequent dialysis therapy could be a potential

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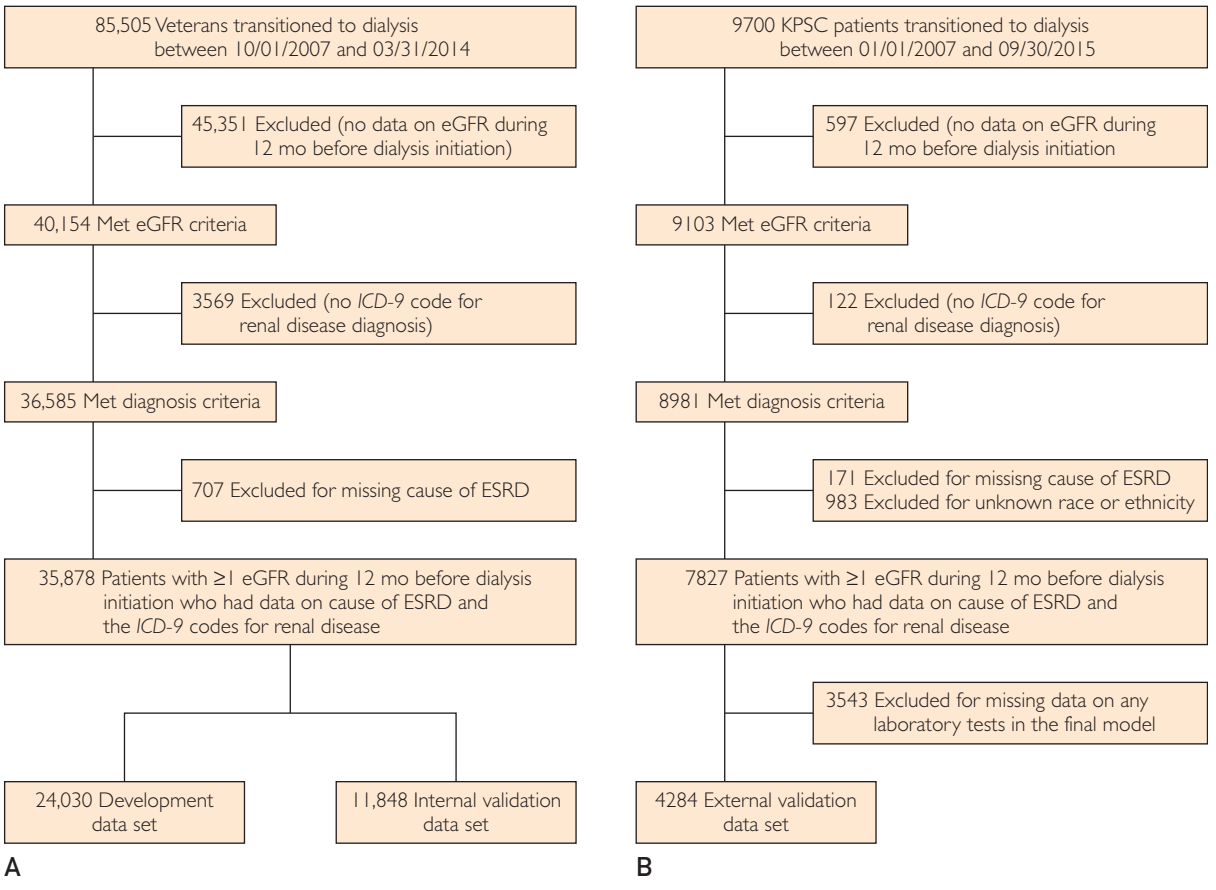

FIGURE 1. Study flowchart of the Veterans Affairs cohort (A) and the Kaiser Permanente Southern California (KPSC) cohort (B). eGFR = estimated glomerular filtration rate; ESRD = end-stage renal disease; *ICD-9* = *International Classification of Diseases, Ninth Revision*.

option.[4-6] Additionally, it may provide little or no benefit but rather harm in such a case to provide aggressive treatments for cancer or certain chronic conditions such as hypertension, atrial fibrillation, or hyperphosphatemia.

Several prediction models have been developed for patients among whom the decision to implement dialysis has been already made.[7-16] However, most of the previous models utilized data obtained at the time of or after dialysis initiation[8-16] despite the fact that the shared decision-making process regarding dialysis initiation would sometimes require several weeks. Other limitations of prior models include small sample sizes,[7-9] restriction of study populations to those of elderly age,[7,10-12] the use of less contemporary cohorts (before 2005),[8,9,12-14] lack of information on race and/or ethnicity,[7-9,11,12,16] and nonconsideration of readily available laboratory data such as serum albumin and/or estimated glomerular filtration rate (eGFR).[7-9,11-16] Additionally, model performance was not externally validated in most cases.[7-13,15]

The aim of this study was to develop, rigorously validate, and provide risk scores to predict mortality during the first year of dialysis (ie, months 3, 6, 9, and 12) based on pre-ESRD information among patients who would transition to dialysis.

PATIENTS AND METHODS

Study Population and Data Source

The Transition of Care in Chronic Kidney Disease study included 2 historical cohorts with incident ESRD: (1) 85,505 US veterans who transitioned to dialysis treatment from October 1, 2007, through March 31, 2014,[17-20] and (2) 9700