

# Discriminators of death and survival in the first year of hemodialysis: Threshold Values and hierarchical importance – The United States Renal Data System

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## Introduction

- Inordinately high mortality in maintenance hemodialysis patients is an ongoing public health in the U.S. International comparisons show that mortality in the US is among the highest in the world.
- In spite of these unfavorable comparisons, mortality rates in US hemodialysis patients have decreased, year-on-year since the early 1990s.
- Among incident patients, these salutary trends are easily apparent, and clinically meaningful, for mortality in the 2nd through 5th years following dialysis inception.
- Mortality rates in the first year, in contrast, have not changed meaningfully in the last decade.
- Few, if any, studies have specifically focused on earlier-phase mortality in new hemodialysis patients.
- Knowing the characteristics that discriminate short-term death from survival might help with the decision to initiate renal replacement therapy.

## Methods

- Among those 18 years and older initiating hemodialysis between May 1st, 2005 and Dec. 31st, 2006, the main objectives of this study were to:
  - identify parameter thresholds with maximum sensitivity and specificity (MaxSn+Sp) for predicting death in the first year of hemodialysis therapy;
  - use classification tree analysis to rank thresholds within and between variables, with successive subgroup formation based on MaxSn+Sp for first-year death; death in the first 30 days of hemodialysis therapy was handled similarly.
- We studied patients  $\geq 18$  years of who initiated hemodialysis between May 1st, 2005 and Dec. 31st, 2006 with arteriovenous fistula, graft or central venous catheter as modes of access, without a prior kidney transplant (n = 156,924).
- Patient characteristics at initiation of dialysis were determined from the USRDS Medical Evidence Form, a federally-minded requirement for all new maintenance dialysis patients.
- Follow-up began at the initiation of dialysis. For 1-year (30-day) mortality, follow-up ended at the earliest occurrence of death or 1-year (30 days) of follow-up. Findings were similar when follow-up with censored transplantation, and only uncensored findings are presented here.

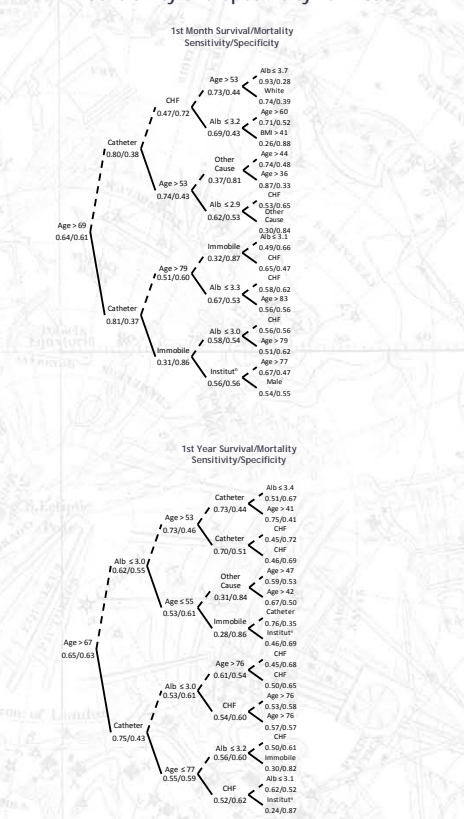
## Results

- Baseline characteristics of the 156,924 patients studied are shown in Table 1.
- 2.3% died within 30 days of starting hemodialysis.
- Age >69 years was the most discriminatory threshold, with sensitivity and specificity values of 0.64 and 0.61, respectively.
- As shown in the classification tree in Figure 1, thresholds related to age, catheter use, serum albumin, congestive heart failure, immobility, institutionalization, cause of end-stage renal disease, race, congestive heart failure, body mass index, sex and race were discriminators of 1st year mortality.
- 25.1% died within 30 days of starting hemodialysis.
- Age >67 years was the most discriminatory threshold, with sensitivity and specificity values of 0.65 and 0.63, respectively.
- Figure 2 shows a classification tree with 5 levels of iteration based on thresholds with MaxSens + Spec. Thresholds related to age, catheter use, serum albumin, immobility, institutionalization, cause of end-stage renal disease and congestive heart failure were represented in the tree, with earliest appearance in the 1st, 2nd, 2nd, 4th, 5th, 5th and 4th iterations, respectively.

Table 1: Baseline Characteristics (n = 156,924)

Fistula	12.9%
Graft	4.6%
Catheter alone	62.9%
Age	63.4 years
Women	44.4%
African American	29.3%
Nephrology care >12 months	21.1%
BMI	28.5 kg/m <sup>2</sup>
Hemoglobin	10.1 g/dl
Albumin	3.1 mg/dl
eGFR	10.5 ml/min
Diabetic renal disease	45.8%
Diabetes	52.8%
Congestive heart failure	35.3%
ASHD	23.1%
CVA	10.4%
PVD	15.4%
COPD	9.5%
Malignancy	7.7%
Immobility	14.0%
Institutionalized	8.1%
Current smoker	6.3%
Alcohol abuse	1.7%
Recreational drug abuse	1.5%

Mortality Classification Trees Based on Maximum Sensitivity and Specificity for Death



## Conclusions

- Along with older age, hypoalbuminemia, and congestive heart failure were dominant associations of early mortality in this study.
- Catheter use (a second iteration entity-after age-that appeared in all 32 subgroups of the 1-year mortality tree) was also a dominant association; catheter use, arguably, might be the most reversible of all major associations.
- While randomized evidence trials are lacking, consensus exists from association studies that native arteriovenous fistulas should be used preferentially for treatment delivery, as central catheters have been linked with blood-borne infections, mortality, and costs.
- The findings of this study lend support to Fistula First Breakthrough Initiative's goal of 66% use of fistulas in US hemodialysis patients.