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Abstract

Aim of the study

to develop and validate a prognostic score for 6-month mortality in elderly patients starting dialysis for end-stage renal disease.

Methods

Using data from the French Rein registry, we developed a prognostic score in a training sample of 2,500 patients aged 75 years or older who started dialysis between 2002 and 2006, which we validated in a similar sample of 1,642 patients. Multivariate logistic regression with 500 bootstrap samples allowed us to select risk factors from 19 demographic and baseline clinical variables.

Results

The overall 6-month mortality was 19%. Age was not associated with early mortality. Nine risk factors were selected and points assigned for the score were as follows: body mass index < 18.5 kg/m^2 (2 points), diabetes (1), congestive heart failure stage III to IV (2), peripheral vascular disease stage III to IV (2), dysrythmia (1), active malignancy (1), severe behavioral disorder (2), total dependency for transfers (3) and unplanned dialysis (2). The median score was 2. Mortality rates ranged from 8% in the lowest risk group (0 point) to 70% in the highest risk group (>=9 points), 17% in the median group (2 points). Seventeen percent of all deaths occurred after withdrawal from dialysis, ranging from 0% for a score of 0–1 to 15% for a score of 7 or higher.

Conclusions

This simple clinical score effectively predicts short-term prognosis among elderly patients starting dialysis. It should help to illuminate clinical decision-making, but cannot be used to withold dialysis. It ought to only be used by nephrologist to facilitate the discussion with the patients and their family.

MESH Keywords Age Factors ; Aged ; Aged, 80 and over ; Female ; France ; Humans ; Kaplan-Meier Estimate ; Kidney Failure, Chronic ; diagnosis ; mortality ; therapy ; Logistic Models ; Male ; Prognosis ; Registries ; Renal Dialysis ; Risk Factors ; Time Factors

Author Keywords Dialysis withdrawal ; Dialysis withholding ; Elderly ; End stage renal disease ; Prognosis score ; Shared decision-making

Introduction

The demand for renal replacement therapy (RRT) is still growing considerably in elderly people with end-stage renal disease (ESRD) and presents a major challenge to health care systems worldwide. Over the past three years, the number of French dialysis patients aged 75 to 84 years rose 10% annually and dialysis rates doubled among those aged 85 years or older. Patients over 75 made up 37% of the total dialysis population in 2006 (1). The survival advantage of RRT in the elderly may, however, be counterbalanced by the burden of treatment and its negative effect on quality of life. Withdrawal from dialysis is not uncommon among elderly patients, and nephrologists must often make decisions about this (2 ,3). Assessing short-term prognosis is therefore important for individualizing care in these patients with multiple comorbidities and functional limitations (4). A prognostic score would be a useful tool for evaluating RRT benefits and risks and informing patients and their families about treatment options.

Generic indices, such as the Charlson Comorbidity Index (5) or the Index of Coexistent Diseases (6), are often used to predict mortality in ESRD studies, but they were not designed for bedside use and include many items irrelevant to kidney disease. The latter limitation also applies to prognostic indices developed in community-dwelling or hospitalized elderly populations (7 –10). Simple

classification systems have been proposed to stratify dialysis patients into groups at low-, moderate-, and high risk of death according to age and comorbid conditions, but their main drawback is that older age is per se a major predictor (11 ,12). The long-term prognostic value of comorbidities and impaired mobility in elderly patients is well-documented (13 –19). In contrast, although a few studies have analyzed risk factors for early death in dialysis patients (20 –24), we lack data about short-term predictors in the elderly ESRD population starting dialysis.

We therefore used data from the national REIN registry to develop and validate a clinical score to assess risk of mortality within 6 months of starting RRT in elderly patients with ESRD.

Methods

Population

The French REIN registry is intended to include all ESRD patients on RRT — either dialysis or transplantation — living in France, including the overseas districts. Patients with a diagnosis of acute renal failure are excluded, i.e., those who recover all or some renal function within 45 days or are considered by experts to have acute failure when they die before 45 days. The registry began in 2002 and is progressively expanding to include the entire country. The details of its organizational principles and quality control have been described elsewhere (25). In this analysis, we included 4,991 patients aged 75 years and over who began dialysis between 1 January 2002 and 30 June 2006 in one of the following 16 regions, which together cover 79% of the French population: Auvergne, Basse-Normandie, Bourgogne, Bretagne, Centre, Champagne-Ardenne, Corse, Haute-Normandie, Ile de France, Languedoc-Roussillon, Limousin, Lorraine, Midi-Pyrénées, Nord-Pas de Calais, Provence-Alpes-Côte d'Azur and Rhône-Alpes. The registry covers 100% of the ESRD patient population in each region.

Data

Baseline information at dialysis initiation included age, gender, primary renal disease, comorbidities, mobility status (walks without help, needs assistance for transfers or totally dependent for transfers), body mass index (BMI), and context of first dialysis. Unplanned dialysis was defined as any first treatment begun in life-threatening circumstances requiring dialysis within 24 hours. Primary renal diseases were grouped into four categories: glomerulonephritis, vascular nephropathy (hypertension or renal vascular disease), diabetic nephropathy, and others, including unknown ESRD causes. In this study we analyzed 13 comorbidities or disabilities: diabetes, congestive heart failure (New York Heart Association stages I to IV), ischemic heart disease (including history of myocardial infarction, coronary vascular disease, coronary artery bypass surgery, angioplasty or abnormal angiography), peripheral vascular disease (Leriche classification stages I to IV), cerebrovascular disease, dysrythmia, chronic respiratory disease, active malignancy, cirrhosis, severe behavioral disorders (including dementia, psychosis or severe neurosis that may affect patient dependence or compliance with treatment), and severe disabilities, including severely impaired vision, amputation and hemiplegia or paraplegia.

Imputation of missing data

The percentage of missing data was less than 10% for all variables except BMI (29%) and mobility status (33%). A multiple imputation strategy (described below) enabled us to make full use of the information from the 4,142 patients with complete data for the remaining 17 variables (83% of the initial sample). The 849 patients excluded were similar to those included with respect to their 6-month mortality rate and differed only slightly in age (mean age 81 in participants and 81.5 years in non-participants), gender (female, 40% vs 45 %), and primary renal disease (diabetic nephropathy, 22% vs. 19%; vascular nephropathy 36% vs. 29%).

Briefly, in multiple imputation, regression models to predict each missing data item are created based on other items (26). These models produce a complete data set that is used for analysis. Within our multiple imputation models, a linear regression model was fitted to predict BMI and a logistic regression model to predict mobility status, based on covariates independently correlated with those items, from data from patients with complete data. For BMI, the linear regression model included age, diabetes, peripheral vascular disease, dysrhythmia, severe behavioral disorders and primary renal disease. For mobility status, the logistic regression model included gender, age, diabetes, congestive heart failure, peripheral vascular disease, cerebrovascular disease, dysrythmia, chronic respiratory disease, active malignancy, severe behavioral disorders, severe disabilities and unplanned dialysis. This procedure was repeated 5 times to account for uncertainty caused by missing data. This resulted in 5 different "complete" data sets, and the final results were averaged across these sets.

Outcome

The primary outcome was overall mortality within 6 months from the first day of RRT. The cohort was followed for a median time of 12 months, until 31 December 2006. In the REIN registry, nephrologists are required to report deaths to the registry on occurrence. Vital status is also checked annually for all patients on December 31, so that event registration can be considered exhaustive. Death after

withdrawal from dialysis is recorded whatever the cause of death, as well as the reason for withdrawal, ie, because of medical complication or patients refusal of dialysis. The distribution of patients by score strata, according to whether or not they were withdrawn from dialysis before death could then be analysed.

Development of the risk score

The total population was randomly divided into two samples. The first one included 2,500 patients (60%) and was used to develop the model (training sample), and the second, including 1,642 patients (40%), was used to validate the model (validation sample) (27).

We analysed crude associations between risk factors and 6-month mortality with logistic regression models (28). To take into account the uncertainty due to the sampling and to introduce some variability, we randomly drew 100 samples with replacement for each imputed dataset (29), i.e., 500 samples (5 for multiple imputation * 100 for bootstrap). The proportion of times that the Wald test showed a p value < 0.05 for each of the risk factors provides information about the strength of the evidence that it was an independent predictor of mortality. We then carried out logistic regression analyses including all predictors with an inclusion frequency exceeding 50% and finally selected those that were significantly associated with mortality. In the final model, variables with more than two modalities were recoded as dichotomous variables whenever only one of these modaliies was significantly associated with mortality (for example mobility).

A scoring system was then constructed in which points were assigned to each risk factor by using the β-coefficients (parameter estimates) from the final logistic regression model. The β-coefficient for each risk factor was divided by the lowest β-coefficient and rounded to the nearest integer. A risk score was then computed for each patient by adding the points for each risk factor present (30).

Generalizability (reproducibility and transportability) (31)

The point scoring system was applied to the validation sample. The accuracy of the score was assessed in the 5 imputed validation samples with the mean c-statistic (discrimination), the Hosmer-Lemeshow goodness-of-fit test and calibration curves (calibration). The c-statistic, which is equivalent to the area under the receiver operating characteristic curve (AUC), assesses the ability of the score to distinguish high-risk from low-risk subjects. When the AUC is greater than 0.7 the model has acceptable discriminatory power. The Hosmer-Lemeshow goodness-of-fit test compares the predicted and observed probability of death. A p-value >0.05 suggests that the model is accurate, on the whole. The calibration curve evaluates the accuracy in different subgroups at risk. The reproducibility of our score was assessed by comparing the mortality rates between the training and the validation samples according to score strata. Initially, patients were divided by risk scores into 5 risk groups of roughly equal size (20%) but the highest group (>=5) did not seem clinically relevant to us that is why we split it into 3 groups: 7 corresponding to the 95^{th} percentile and 9 to the 99^{th} percentile. We used Kaplan-Meier survival curves to examine the performance of our prognostic score over time. The follow-up period transportability of the model was tested in the validation sample at 3 and 12 months. Statistical analyses were performed with SAS software, version 9.0 (SAS Institute, Inc., Cary, NC). Simultaneous regression parameter estimations and multiple imputations were carried out with proc MI implemented in SAS software.

Results

Patient characteristics at baseline

The total population was randomly divided into a training sample of 2,500 patients (60%), which was used to develop the score, and a validation sample of 1,642 patients (40%) to validate it. The mean age of patients in the training sample was 80.9+/−4.1 years and in the validation sample 81.1+/−4.1 years. The distribution of patient characteristics did not differ between samples (Table 1). Impaired mobility was present in 34%, 5% had at least one severe disability, 86% at least one comorbidity and 36% three or more comorbidities. After multiple imputations, the training sample and the validation sample did not differ regarding the distribution of body mass index (p=0.13) and mobility status (p=0.77).

Risk factors for early death

A total of 776 patients died within 6 months (19%). The six-month mortality rate was 18.8% in the training sample and 18.7% in the validation sample. Older age was not associated with a higher risk of early mortality (Table 2). The crude analysis identified 14 factors significantly associated with increased mortality: low body mass index (BMI), primary renal disease, diabetes, peripheral vascular disease (stage III or IV), cerebrovascular disease, congestive heart failure, dysrythmia, active malignancy, chronic respiratory disease, cirrhosis, severe behavioral disorder, amputation, impaired mobility and unplanned dialysis. Multivariate logistic regression identified nine independent predictors of mortality at 6 months: body mass index < 18.5 kg/m^2 , diabetes, congestive heart failure stage III to IV, peripheral vascular disease stage III to IV, dysrythmia, active malignancy, severe behavioral disorder, total dependency for transfers, and unplanned dialysis (Table 3).

Point scoring system

The number of points assigned to each of the nine independent risk factors are listed in Table 3 . A risk score was calculated for each patient by adding up these points. Risk scores ranged from 0 to 12 points (median 2) in the training sample and 0 to 13 (median 2) in the validation sample. The accuracy of the score applied to the validation sample was acceptable, with a mean c-statistic of 0.70 and a mean p for the Hosmer-Lemeshow goodness-of-fit test of 0.93. The calibration curve showed good concordance between observed and predicted mortality among the predicted risk subgroups (Figure 1). The similarity of the mortality rates in the training and validation samples within each stratum also reflected good score calibration (Table 4). In the validation sample, 6-month mortality ranged from 8% in the lowest-risk group (0 points) to 70% in the highest-risk group (9 points or more). The Kaplan-Meier survival curves depict a gradient: risk increases with the score, in both the training and validation samples (Figure 2). The Log-Rank Test of Equality over Strata showed highly significant differences ($p<0.0001$) in both samples.

A hundred and thirty patients died after withdrawal from dialysis (17%). The percentage of patients who were withdrawn from dialysis increased strongly with the score (Figure 3): chi-square test comparing the distribution of patients according to vital status and withdrawal from dialysis across score points, $p<0.001$.

Our score showed transportability was good for the follow-up periods: of 3 months and 12 months, for which the mean c-statistic was 0.74 and 0.68, respectively, and the mean p for Hosmer-Lemeshow goodness-of-fit test was 0.29 and 0.88.

Discussion

We developed a prognostic score that effectively stratifies elderly ESRD patients into groups at varying risk of early death after starting dialysis. It is simple, based on easy-to-collect variables from routine clinical evaluation and requires no laboratory or radiology testing. It was built from a large unselected registry-based population with prospective data collection and showed good reproducibility in a validation sample.

A previous study of 822 incident patients concluded that no existing scoring system could accurately predict death within 6 months of starting dialysis because of the low predictive value of the different models analyzed (20). Our study does not support this conclusion, since the score we developed showed a wide range of survival from 92% to less than 40% from the lowest (0 points) to the highest risk groups (9 or more points). It improves on existing indices (5 ,6) and classification systems (11 ,12) in that it is based on the comorbid conditions that are most common among dialysis patients and weighted according to their relation to mortality.

The factors independently predictive of mortality at 6 months were low BMI, diabetes, congestive heart failure stage III to IV, peripheral vascular disease stage III to IV, dysrythmia, active malignancy, severe behavioral disorder, impaired mobility and unplanned dialysis. These findings are consistent with those from a large study of dialysis patients aged 65 years and older that found congestive heart failure, cerebrovascular disease, peripheral vascular disease and late referral to be associated with an increased 90-day mortality risk, and diabetes, congestive heart failure and malignancy to be associated with increased risk between day 91 and 180 (19). Our findings are also consistent with those observed in younger ESRD patients from three large US and Canadian cohorts (20 , 21 , 23). In contrast to previous studies of elderly patients (15 ,16 ,19), however, age was not an independent risk factor for mortality here. This suggests that age per se , at least within the range we studied — from 75 to 98 years — should not be a contraindication for starting RRT. Our study also provides further evidence of the importance of assessing functional limitations, specifically, dependency for transfers, which may reflect the impact of illnesses and frailty. This information was not available in previous studies, but data of a similar nature, such as nonambulatory status (15) and Karnofsky score (14), were associated with long term mortality in elderly patients on dialysis. This is also consistent with works that use surrogate markers for frailty (e.g., impaired mobility and severe behavioral disorders) to predict mortality (7 –10). Finally, 40% of the elderly French ESRD patients started with unplanned dialysis, which was unsurprisingly associated with high mortality risk, consistent with the well-known fact that patient outcome is worst when pre-dialysis care is shortest (32 ,33). However, the REIN registry definition for unplanned dialysis does not fully match that of so-called late referral, since about half of these patients starting dialysis in life-threatening circumstances were timely referred to a nephrologist. Despite that, these data show that delaying the start of dialysis in elderly patients may jeopardize the outcome of these patients. This means that after discussion with the patient and his family, if the decision to consider dialysis is taken, it should be planned early, in good condition of preparation, at least in patients timely referred to the nephrologist.

Clinical practice guidelines on shared decision-making regarding dialysis encourage physicians to provide clear information to patients about “diagnosis, prognosis and all treatment options which should include: (1) available dialysis modalities; (2) not starting dialysis and continuing conservative management including end-life care; (3) a time-limited trial of dialysis; and (4) stopping dialysis and receiving end-life care ” (34 ,35). Multiple studies have shown that patients expect clinicians to discuss prognosis with them (36). To our knowledge, this is the first prognostic score for predicting early death (6 months) in elderly ESRD patients. It provides a quantitative estimate of survival expectancy that can be used to support clinical judgment about prognosis. It can clearly identify elderly patients at very low risk, who are in the best position to benefit from RRT. On the other hand, it may also help to identify patients at high risk of early

death with whom conservative treatment may be discussed (37 –39). The ethical issue of this prognosis score has to be considered carefully. Prediction tools are helpful but only when balanced with good clinical judgement. That is why this score should not be used to withhold dialysis. It ought not be used outside the clinical settings, for example by health insurances or administration to deny dialysis. It should instead be considered to be a tool to assist clinicians in better meeting patients' needs and preferences in the light of realistic expectations and to help the physicians to interact more productively with patients and their families about this difficult topic (4). Moreover, it has been shown that denying access to dialysis to high risk patients generates limited cost savings and may sacrifce otherwise long-term survivors (40).

Several methodological considerations should be taken into account in evaluating these findings. First, our score showed moderate discrimination (mean c statistic 0.70) but good calibration, as reflected by the good concordance between observed and expected mortality rates in the validation sample. The relative importance of calibration and discrimination depends on the intended application. If predictions are used for counselling patients, the accuracy of the numeric probability (calibration) is important (31). High c values may reflect overfitting of data, which compromises the transportability of the prognostic index. Calibration is also important in health services research for the comparison of predicted and observed mortality rates to identify unexpectedly high or low rates. Some laboratory variables may have further increase the accuracy of the model, but we choose to base this score only on clinical variables easy to use in non-hospitalised patients.

Second, although research assistants conduct data quality control, some data were missing, particularly for BMI and mobility status, and we cannot rule out the possibility that other comorbid conditions may also have been misclassified or underascertained. To overcome selection bias due to missing data, we combined multiple imputations and bootstrap techniques to select the variables to be included in the final model (29). If, as we assumed, these data were missing at random, they would be correctly predicted by the non-missing data. This method allowed the regression analyses for BMI and mobility status to include 83% of the patients. Multiple imputations and bootstrap techniques are likely to have both reduced bias and increased study power.

Third, despite high reproducibility in the validation sample, the transportability of the score remains to be tested in other populations (31). Although the simplicity of the model makes underfitting more likely, overfitting is still possible. We plan to test historical transportability with further incident patients from the REIN registry. It would also be interesting to test geographic transportability with data from other ESRD registries that collect similar data. We demonstrated the good accuracy of our model for 3 and 12-month mortality, indicating the transportability of follow-up period but our model may degrade over longer follow-up periods because factors related to long-term mortality, such as age, may be missing (13 ,15).

Fourth, because this study was based on RRT registry, no information was available about ESRD patients who were not referred to nephrologists or did not receive dialysis. It is likely that elderly ESRD patients initiating dialysis are selected and healthier than their counterparts who did not. Our model may therefore not be generalizable to the entire population of elderly ESRD patients. We have planned to carry out a prospective survey to test our score in a cohort of patients with ESRD stage 5, before renal replacement therapy. Meanwhile, we suggest to use this score to assess prognosis only in patients with no obvious contra indication for dialysis. In patients with poor conditions, this score cannot indeed replace medical expertise. In contrast, it may be particularly useful in hesitant patients, at low risk to reassure them about their probability to survive. Interestingly, Joly et al. used data from a single-center cohort of 146 pre-ESRD octogenarians with eGFR of 10 ml/min/1.73 m^2 referred to a nephrology unit over a 12-year period (1989 to 2000) and determined that 26 % of them were offered conservative measures (14). These patients had slightly lower Karnofsky scores, were more likely to be socially isolated, to have been referred late (less than 4 months) or to have diabetes mellitus than those who were offered RRT. Major comorbid conditions, however, were similar for the two groups.

In conclusion, this score, which relies solely on routine clinical evaluation, is a simple and accurate tool to assess short-term prognosis in elderly ESRD patients starting dialysis. It should help to illuminate clinical decision-making about treatment options, but cannot be used to withold dialysis.

Ackowledgements:

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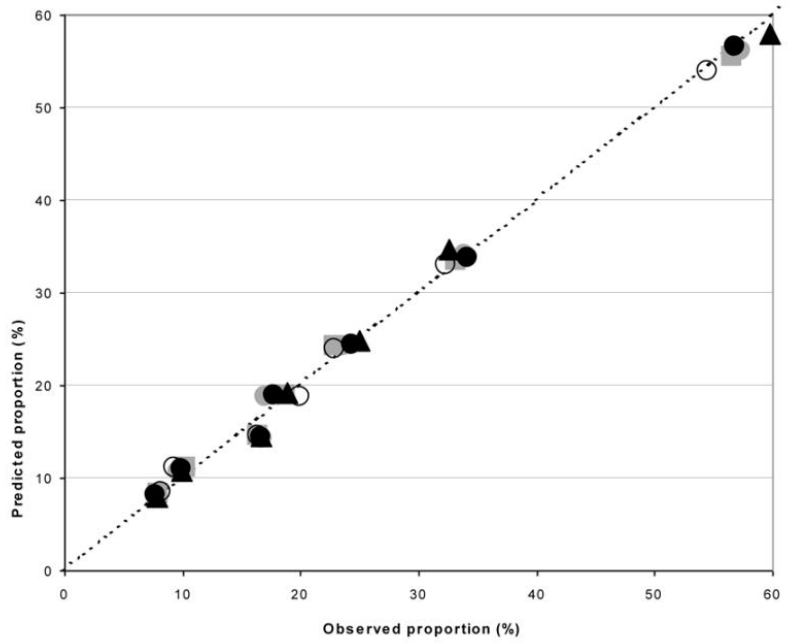
Figure 1

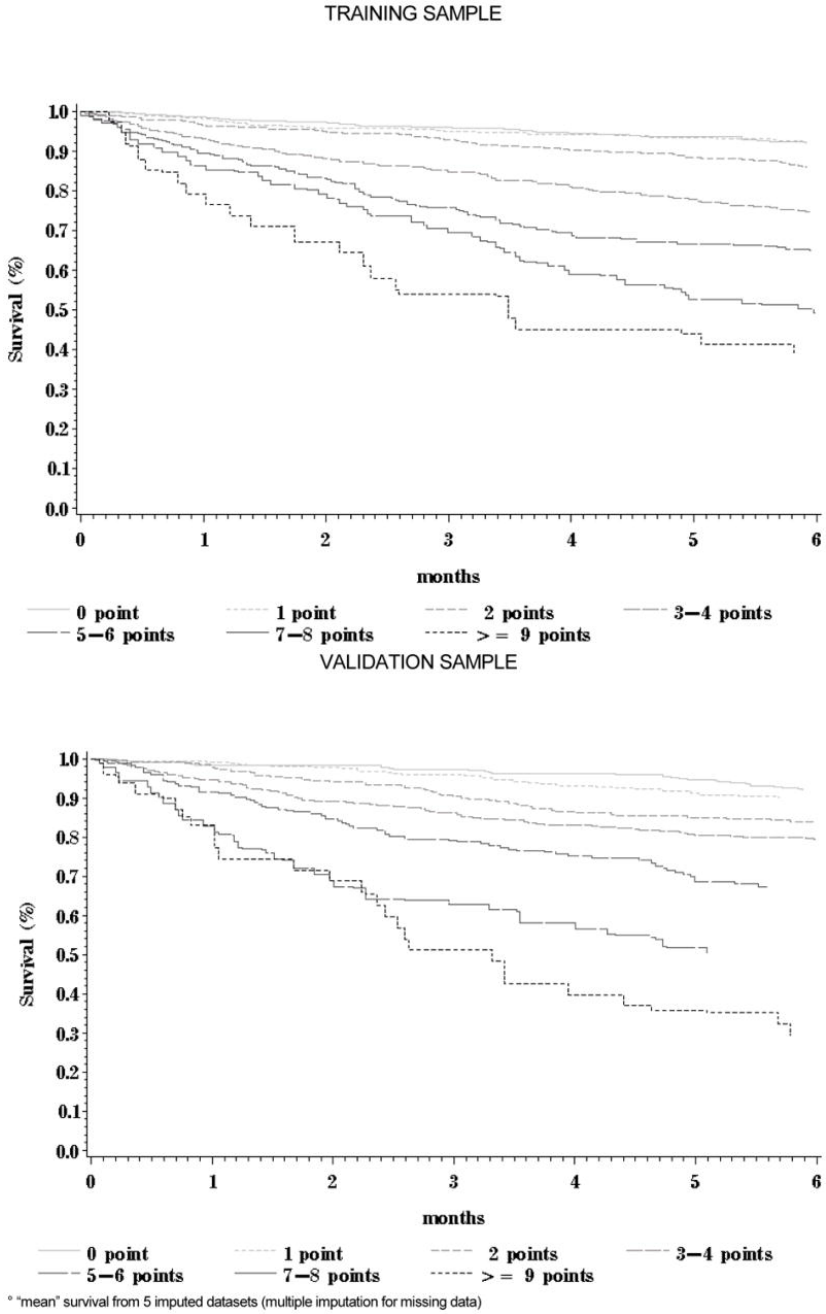
Calibration curve: observed and predicted* 6-month mortality in the validation sample by group of predicted risk (Hosmer-Lemeshow test)



* 6-month mortality predicted by score-based logistic regressions in the 5 imputed datasets (multiple imputation for missing data)
▲ ■ ○ ● ● : each sign correspond to one imputed dataset

Figure 2

Survival by point score groups in the training sample and the validation sample[o]



° "mean" survival from 5 imputed datasets (multiple imputation for missing data)

Figure 3

Distribution of patients in the validation sample, by score strata, according to vital status and whether or not they were withdrawn from dialysis within 6 months after starting dialysis[o o] "mean" frequency from 5 imputed datasets (multiple imputation for missing data)

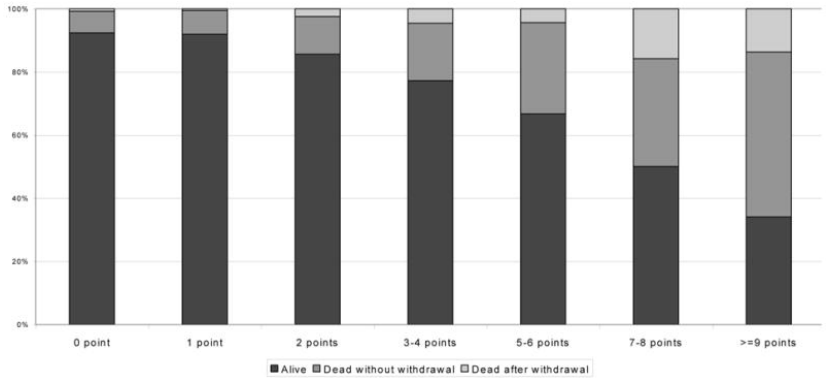


Table 1
Patient characteristics at baseline

Characteristics	Training sample (n = 2500)		Validation sample (n = 1642)		p value[$]
	N	%	N	%	
Gender					
Male	1509	60,4	977	59,5	0,6
Age (years)					0,2
75–79	1192	47,7	728	44,3	
80–84	925	37,0	648	39,5	
85–89	302	12,1	213	13,0	
90–94	69	2,8	48	2,9	
95 and over	12	0,5	5	0,3	
Body mass index (kg/m^2) [*]					0,1
<18,5	164	6,6	116	7,1	
[18,5–25[	1232	49,3	859	52,3	
>= 25	1103	44,1	667	40,6	
Primary renal disease					0,8
Glomerulonephritis	158	6,3	604	6,2	
Vascular nephropathy	881	35,2	347	36,8	
Diabetic nephropathy	550	22,0	0	21,1	
Other and unknown	911	36,4	101	35,9	
Comorbidities and disabilities					
Diabetes	933	37,3	582	35,4	0,2
Ischemic heart disease					0,1
Without myocardial infarction	478	19,1	292	17,8	
Myocardial infarction	401	16,0	239	14,6	
Peripheral vascular disease					0,8
Stage I or II	514	20,6	333	20,3	
Stage III or IV	232	9,3	152	9,3	
Cerebrovascular disease	311	12,4	210	12,8	0,7
Congestive heart failure					0,8
Stage I or II	595	23,8	371	22,6	
Stage III or IV	354	14,2	260	15,8	
Dysrythmia	799	32,0	501	30,5	0,3
Active malignancy	231	9,2	168	10,2	0,3
Chronic respiratory disease	335	13,4	218	13,3	0,9
Cirrhosis	22	0,9	12	0,7	0,6
Severe behavioural disorder	114	4,6	83	5,1	0,5
Severely impaired vision	48	1,9	30	1,8	0,8
Haemiplegia or paraplegia	39	1,6	22	1,3	0,6

Amputation	50	2,0	34	2,1	0,9
Mobility *					0,8
Walk out help	1673	66,9	1074,6	65,4	
Need assistance for transfers	619	24,7	418,2	25,5	
Totally dependent for transfers	208	8,3	149,2	9,1	
Initial context					
Unplanned dialysis	859	34,4	586	35,7	0,4

* "mean" distribution after multiple imputation

$ Chi-square tests: comparisons of the distribution between each sample

Table 2

Crude odds-ratios for 6-month mortality according to patient characteristics in the training sample $ and percentages of p-values <0.05 for each risk factor among 500 random datasets

	Deaths (n= 470)		OR [95% CI]		p	Percentage of p-values <0.05 in 500 datasets *
	N	%				%
Gender						
Male	290	19,2	1			
Female	180	18,2	0,9	[0,8 – 1,1]	0,51	47
Age (years)						
75–84	387	18,3	1			
85 and over	83	21,7	1,2	[0,9 – 1,6]	0,12	17
Body mass index (kg/m²)						
<18,5	45	27,6	1,4	[1,1 – 1,9]	0,01	74
[18,5–25[	239	19,4	0,9	[0,7 – 1,1]	0,35	28
>= 25	186	16,8	1			
Primary renal disease						
Glomerulonephritis	19	12,0	1			
Vascular nephropathy	144	16,3	1,4	[0,9 – 2,4]	0,42	10
Diabetic nephropathy	131	23,8	2,3	[1,4 – 3,8]	0,0001	61
Other and unknown	176	19,3	1,8	[1,1 – 2,9]	0,186	34
Comorbidities and disabilities o						
Diabetes	214	22,9	1,5	[1,2 – 1,9]	<,0001	61
Ischemic heart disease						
Without myocardial infarction	94	19,7	1,1	[0,9 – 1,5]	0,98	10
Myocardial infarction	86	21,4	1,3	[1,0 – 1,6]	0,23	6
Peripheral vascular disease						
Stage I or II	95	18,5	1,1	[0,8 1,4]	0,024	55
Stage III or IV	73	31,5	2,2	[1,6 – 3,0]	<,0001	74
Cerebrovascular disease	77	24,8	1,5	[1,1 – 2,0]	0,004	40
Congestive heart failure						
Stage I or II	120	20,2	1,4	[1,1 1,8]	0,24	15

Stage III or IV	114	32,2	2,6	[2,0 – 3,4]	<,0001	87
Dysrythmia	196	24,5	1,7	[1,4 – 2,1]	<,0001	66
Active malignancy	60	26,0	1,6	[1,2 – 2,2]	0,003	56
Chronic respiratory disease	78	23,3	1,4	[1,0 – 1,8]	0,02	18
Cirrhosis	8	36,4	2,5	[1,0 – 6,0]	0,03	43
Severe behavioral disorder	45	39,5	3,0	[2,0 – 4,4]	<,0001	76
Severely impaired vision	8	16,7	0,9	[0,4 – 1,9]	0,70	23
Haemiplegia or paraplegia	10	25,6	1,5	[0,7 – 3,1]	0,27	15
Amputation	15	30,0	1,9	[1,0 – 3,5]	0,04	18
Mobility						
Walk out help	207	12,4	1			
Need assistance for transfers	171	27,6	1,1	[0,9 – 1,3]	0,3502	7
Totally dependent for transfers	93	44,5	2,3	[1,9 – 2,8]	<,0001	100
Dialysis start						
Planned	224	13,7	1			
Unplanned	246	28,6	2,5	[2,1 – 3,1]	<,0001	100

$ The total number of 500 data sets was equal to 5 (number of imputations for missing data) * 100 (number of bootstrap samples).

* percentage of times where the risk factor was significantly ($p<0.05$) associated with 6-month mortality in the regression models (Wald test).

o OR for the presence vs absence of each comorbidity or disability. OR (95% CI): odds-ratio (95% confidence interval)

Table 3

Adjusted odds-ratios for 6-month mortality and points assigned to each risk factor in the training sample

Risk factors	Adjusted OR[o]	95%CI	β-coefficient	Points[§]
Body mass index (kg/m ^{2})				
>= 18,5	1			
<18,5	1,3	[1,1 – 1,6]	0,283	2
Diabetes				
Absence	1			
Presence	1,2	[1,1 – 1,3]	0,180	1
Congestive heart failure stage III or IV				
Absence	1			
Presence	1,3	[1,2 – 1,5]	0,289	2
Peripheral vascular disease stage III or IV				
Absence	1			
Presence	1,3	[1,1 – 1,5]	0,269	2
Dysrythmia				
Absence	1			
Presence	1,2	[1,1 – 1,3]	0,170	1
Active malignancy				
Absence	1			
Presence	1,3	[1,1 – 1,5]	0,250	1
Severe behavioral disorder				
Absence	1			
Presence	1,5	[1,2 – 1,8]	0,391	2
Totally dependent for transfers				
Absence	1			
Presence	1,7	[1,4 – 2,0]	0,519	3
Initial context				
Planned	1			
Unplanned	1,5	[1,3 – 1,7]	0,395	2

o "mean odds-ratio" for the 5 imputed datasets (multiple imputation for missing data). OR (95% CI): odds-ratio (95% confidence interval)

§ Points were assigned to each risk factor using β-coefficients (parameter estimates) from the multivariate logistic regression model. The β-coefficient for each risk factor was divided by the lowest β -coefficient (dysrythmia) and rounded to the nearest integer.

Table 4

Six-month mortality rates by risk score in the training and the validation samples

Risk score	Training sample			Validation sample		
	Number of death[o]	Number at risk[o]	%	Number of death[o]	Number at risk[o]	%
0 point	41	511	8%	26	330	8%
1 point	39	508	8%	33	339	10%
2 points	64	453	14%	49	294	17%
3–4 points	160	628	26%	82	399	21%
5–6 points	93	266	35%	59	178	33%
7–8 points	50	98	51%	32	64	50%
>=9 points	22	36	62%	25	35	70%
	470	2500	19%	306	1640	19%

[o] "mean" number of patients from the 5 imputed datasets (multiple imputation for missing data)