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# Fatality and hospitalization in hemodialysis patients in a health plan

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## ABSTRACT

**OBJECTIVE:** To analyze clinical outcomes of patients on hemodialysis linked to health care plan provider

**METHODS:** Cohort study of hemodialysis events in Belo Horizonte, MG, Southeastern Brazil, between 2004 and 2008, based on records from health care plan provider databases. The independent variables were: sex, age, time between first appointment with nephrologist and starting hemodialysis, type of first vascular access, diabetes mellitus, length of time spent in hospital/year of treatment and death. Dependent variables: time between starting hemodialysis and death and length of time spent in hospital/year of treatment > 7.5 days. Statistical analysis was carried out using Pearson's Chi-squared test in the univariate analysis for the outcomes 'death' and 'length of time spent in hospital/year of treatment'; the Kaplan-Meier method was used to analyze survival; the Cox model and Poisson regression were used for risk of death and chance of length of time spent in hospital/year of treatment >7.5 days. The Business Intelligence tool and Stata ® 10.0 software were used to extract data.

**RESULTS:** There were 311 patients on hemodialysis included in the study, with a mean age of 62 (sd 16.6 years), of whom 55.5% were male. Prevalence increased 160% during the period in question. Survival analysis showed a higher mortality among older patients, patients that did not consult a nephrologists, those whose first vascular access was using a temporary catheter,, those with diabetes mellitus, those admitted to hospital within a month of beginning hemodialysis. The Cox model showed that a higher risk of death was associated with age, diabetes mellitus, not consulting a nephrologists and those that were hospitalized within a month of beginning hemodialysis. Greater length of time spent in hospital/year of treatment was not associated with sex or diabetes. According to Poisson regression, the variables were not significant.

**CONCLUSIONS:** Assessment by a specialist before starting hemodialysis decreases the risk of death in cases of chronic kidney disease, whereas the presence of diabetes and being hospitalized within a month of beginning hemodialysis increases the risk of death.

**DESCRIPTORS:** Renal Insufficiency, Chronic, complications. Renal Dialysis, mortality. Risk Factors. Diabetes Complications. Prepaid Health Plans.

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## INTRODUCTION

Chronic renal disease (CRD) is an important condition in the epidemiological and demographic transition of various countries, including Brazil. Among its etiological factors, diabetes mellitus and systemic arterial hypertension stand out as the most frequent underlying causes.<sup>16</sup>

Cases of CRD almost quadrupled in the United States in the 1990s. The Brazilian Nephrology Society (BNS) identified 73,605 patients with TCRD (terminal) in dialysis treatment in Brazil in 2007. The prevalence rate was 333 per million inhabitants (pmp) in 2004, increasing to 391 pmp in 2007 (increase of 8.1%).<sup>21</sup>

The impact on the life expectancy of TCRD patients on renal replacement therapy (RRT) – dialysis (hemodialysis – HD) and peritoneal dialysis and kidney transplantation – are well established. Individuals on RRT have a lower life expectancy than those of the same age and sex in the general population.<sup>7,9</sup> Mortality is influenced by individual factors such as age, underlying cause of CRD and comorbidities and factors relating to the use of health care services such as delayed referral to a nephrologist, use of temporary vascular access and hospitalizations.<sup>16,19,25</sup>

The increased incidence and prevalence of patients with TCRD and the impact of treatment of RRT on national health systems' spending has attracted the attention of managers. Similarly to what has happened in the world, the challenges faced in Brazil range from the systematic collection of data, through the interventions in determinants of risk, adequate supply of quality services and the financing of the sector.

In spite of additional regulation (law 9,656/98) having RRT coverage compulsory, until recently the panorama of provision of these services and the sources of financing did not substantially change. The Brazilian Unified Health System (SUS) for around 90% of RRT. The same is seen in publications in which the majority of studies on the epidemiological, clinical and economic aspects of RRT in Brazil use data from patients and services funded by the SUS. The analyses referring to TCRD patients in health care plans are incipient.

This study aimed to analyze clinical outcomes of patients on hemodialysis linked to a health care plan provider.

## METHODS

Observational, non-concurrent study using an open historical cohort of patients on HD between January 2004 and December 2008 and registered in the database of a health care plan provider in the metropolitan region of Belo Horizonte, MG, Southeastern Brazil, with around 600,000 beneficiaries. The Ministry of

Health Department of Health Monitoring Mortality Information System was used to confirm deaths.

Individuals who started hemodialysis in the period, were aged over 18 and received treatment for more than three consecutive months in a service network directly contracted by the provider were eligible. Patients who had declared chronic renal disease as a pre-existing condition when they signed up with the provider and who had a difference of more than 12 months between starting coverage by the provider and the date of their first HD session were excluded.

There were 592,707 beneficiaries registered with the provider in July 2008, 45% males, with a mean age of 42 (standard deviation – sd 17.2 years); 13% of the beneficiaries were aged over 65. There were 311 individuals in hemodialysis included in the study, 55% were men, the mean age was 62 (sd: 16.6 years) and 48% were > 65. The median length of contract with the provider was nine years.

The independent variables were: a) demographic characteristics (sex, age); b) clinical characteristics: consultation with nephrologist (early referral – the consultation took place up to four months before HD started; delayed consultation – the consultation took place less than four months before HD started; no consultation); first vascular access (temporary vascular catheter – TVC); arteriovenous fistula; presence of diabetes mellitus as a comorbidity; length of treatment; hospitalizations (occurring in the same month as the start of treatment until the outcome, excluding those lasting only one day and those related to kidney donation for the beneficiary); time spent in hospital per year of treatment (THYT) starting from the first day of HD, excluding the days of hospitalizations for which death was the outcome; and c) outcome characteristics (death, continuing in treatment or lost follow up). The THYT was described in two categories, using the median as reference: fewer or more than 7.5 days of hospitalization per year of treatment.

The dependent variables were: time between date of starting hemodialysis until date of death and THYT > 7.5 days.

Descriptive analysis was performed using frequency distributions, measures of central tendency and variability for the characteristics studied. The  $\chi^2$  test was used to analyze differences in proportions between the categorical variables. The rate of prevalence of patients in HD was calculated per million patients.

There were 49 patients whom the study was unable to follow up, nine who left the provider and 19 who underwent kidney transplants.

The Kaplan-Meier method was used to estimate survival curves compared using the log-rank test, with 5% being the level of significance. The Cox proportional hazard model (hazard ratio) was used to identify independent effect of the explanatory variables of survival. The assumption of the proportionality of risk was assessed by graphical analysis of Schoenfeld residuals. The relevance of each variable included in the multiple model was verified using the Wald statistic, those which did not contribute significantly being excluded from the model and those which were statistically significant remaining in the final model ( $p \leq 0.05$ ).

The BI (Business Intelligence) Prodigé® tool was used to extract data from the provider's database (Data Warehouse) and Stata® 10.0 for the statistical analysis.

This study was approved by the Research Ethics Committee of the *Faculdade de Medicina, Universidade Federal de Minas Gerais* (Process nº ETIC 437/08) and authorized by the Research Committee of the Medical Work Cooperative, Belo Horizonte.

## RESULTS

There were 592,707 beneficiaries registered with the provider in July 2008, 45% were male, the mean age was 42 (standard deviation – sd 17.2 years); 13% of the beneficiaries were aged over 65. There were 311 individuals on hemodialysis included in the study, 55.5% were male, the mean age was 62 (sd: 16.6 years) and 48% were aged over 65. The median length of contract with the provider was nine years.

The increase in prevalence was 160%: from 127 pmp in 2004 to 331 pmp in 2008 ( $p < 0.001$  Cochran-Armitage).

Most of the patients undergoing hemodialysis had seen a nephrologist before starting renal replacement therapy, used TVC as the initial access, had spent  $\leq 12$  months in treatment and had been hospitalized in the same month as HD started. Almost half of the beneficiaries had diabetes mellitus (Table 1).

Death was linked to age in the uni-variate analysis of the first model and 68% of deaths occurred in individuals aged  $> 65$ . The majority of those who did not die had consulted a nephrologist up to four months before starting HD. The majority of patients who went on to die had been in treatment for  $< 1$  year (77%) and had been hospitalized in the same month in which HD started (84%). There were more deaths in diabetic individuals.

There was no association between THYT or sex and death (Table 1). The older beneficiaries, those with no recorded consultation with a nephrologist, those using TVC as the initial access for HD, diabetics and those who had been hospitalized in the same month in which HD started had lower survival rates (Figure). Survival rates

of diabetics in the 1<sup>st</sup>, 2<sup>nd</sup> and 5<sup>th</sup> year were, respectively, 61.4%, 48.7% and 18.6%; in the non-diabetics they were 71.9%, 65.2% and 46.8%, respectively.

In the final Cox model of proportional hazard, risk of death increased with age, with not having seen a nephrologist, with diabetes mellitus and with being hospitalized in the same month in which HD started (Table 2). Analysis of Schoenfeld residuals confirmed the assumption of the proportionality of risks, as no trend was observed in the residual diagrams.

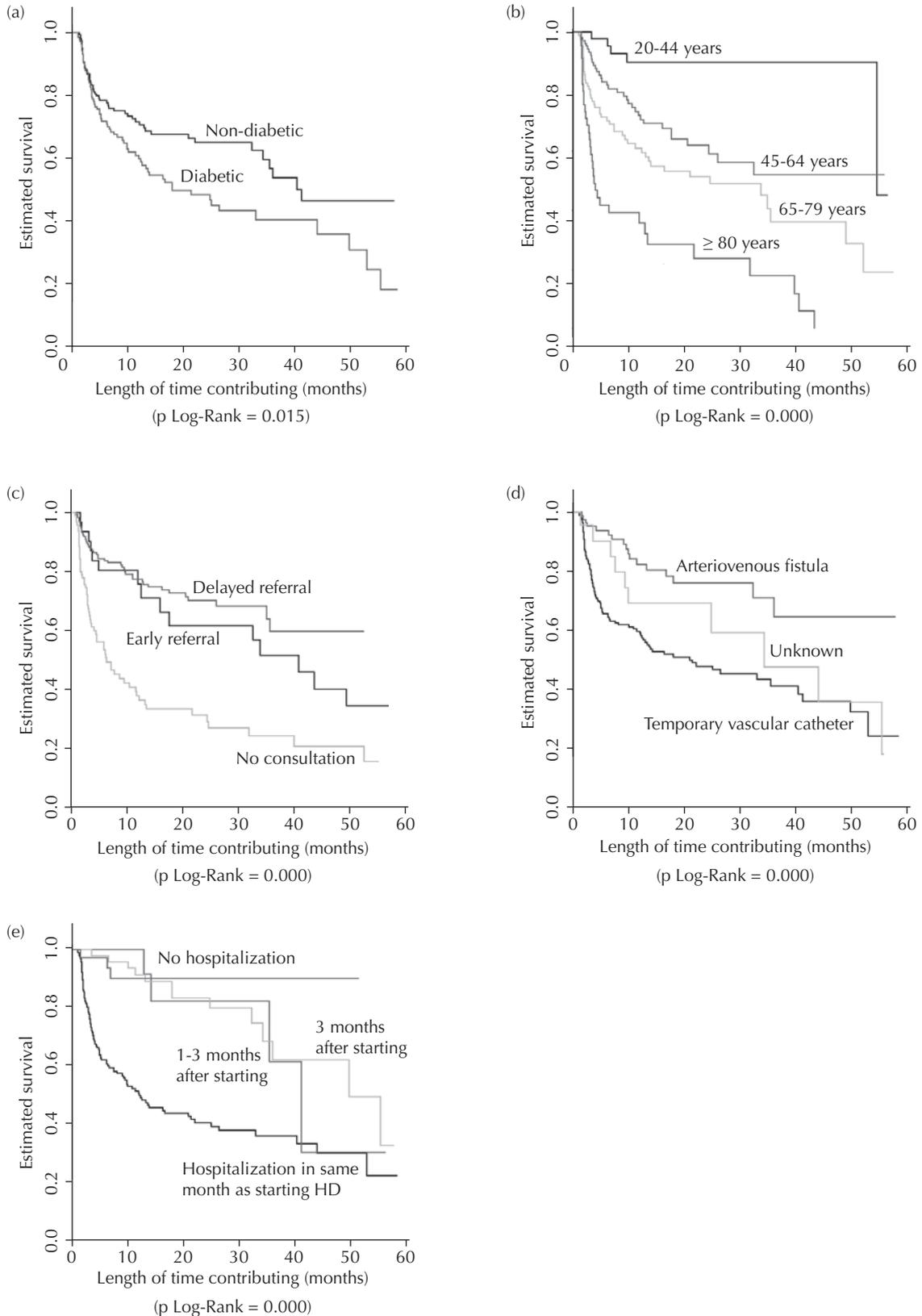
The majority of patients with THYT  $> 7.5$  days were aged 65 and over, with TVC as the first vascular access, were in dialysis treatment for a period  $\leq 12$  months, were diabetic, had been hospitalized in the same month in which HD started and had diabetes mellitus, according to uni-variate analysis of the second model (Table 3). None of the variables tested using Poisson Regression were significant.

## DISCUSSION

This is the first Brazilian study in the field of supplementary health care which approaches the epidemiological profile of service use and of HD patients. The study shows an increase in the prevalence of TCRD in the provider, greater risk of this leading to death linked to age, patients failing to be seen by a nephrologist beforehand, diabetes and being hospitalized in the same month in which HD started.

An increase of 160% was observed in the prevalence of patients in hemodialysis treatment between 2004 and 2008. The prevalence of TCRD in Latin America has increased by around 10% per year.<sup>6</sup> On the other hand, incidence increased by less in the period analyzed. Some factors may have contributed to this, such as not including patients who had declared renal disease as a pre-existing condition or who opted to temporarily suspend coverage. Patients whose health care plans did not include chronic HD and, thus, carried out their treatment through the SUS or changed provider were also not calculated.

Males were more prevalent, similar to data recorded in other studies.<sup>7,15,16</sup> The mean age of the participants was 62. The global mean age, in a European study, was 60.4 years old (sd: 15.2 years)<sup>16</sup> and in the dialysis center – *Centro de Diálise Einstein* in Sao Paulo the mean was 63.1 (sd: 16.1 years).<sup>12</sup> Studies of SUS patients showed a median age of 45<sup>3</sup> and the mean age was 48.9 (sd: 14.8 years).<sup>11</sup> In a study by Sesso et al<sup>22</sup> of patients treated by the SUS and by private providers, the mean age was 59 years old (sd: 23 years).<sup>22</sup> The figures suggest that patients with TCRD studied in this cohort had a similar age profile to those in the European countries studied and to those in other services which only treat patients with private health insurance, such as the



**Figure.** Kaplan-Meier curves for the event of death with the following co-variables: (a) Diabetes, (b) Age group, (c) Consultation with nephrologist, (d) First vascular access, (e) Hospitalizations. Belo Horizonte, MG, Southeastern Brazil, 2004.

**Table 1.** Deaths according to demographic characteristics and health care service use by patients on hemodialysis. Belo Horizonte, MG, Southeastern Brazil, 2004 to 2008.

Characteristics	Death						p
	No (n = 189)		Yes (n = 122)		Total (n = 311)		
	n	%	n	%	n	%	
Sex							0.255
Male	110	58.2	63	51.6	173	55.6	
Female	79	41.8	59	48.4	138	44.4	
Age group (years)							0.000 <sup>a</sup>
20 to 44	46	24.3	5	4.1	51	16.4	
45 to 64	75	39.7	34	27.9	109	35.0	
65 to 79	57	30.2	49	40.2	106	34.1	
80 and over	11	5.8	34	27.9	45	14.5	
Consultation with nephrologist (months)							0.000 <sup>a</sup>
Delayed referral < 4	17	9.0	15	12.3	32	10.3	
Early referral ≥ 4	135	71.4	45	36.9	180	57.9	
No consultation	37	19.6	62	50.8	99	31.8	
1 <sup>st</sup> vascular access							0.000 <sup>a</sup>
Catheter	107	56.6	95	77.9	202	65.0	
Fistula	68	36.0	17	13.9	85	27.3	
Unknown	14	7.4	10	8.2	24	7.7	
Length of time in treatment (months)							0.000 <sup>a</sup>
Up to 12	85	45.0	94	77.0	179	57.6	
13 to 24	48	25.4	14	11.5	62	19.9	
25 to 36	31	16.4	8	6.6	39	12.5	
37 to 48	13	6.9	3	2.5	16	5.1	
49 to 60	12	6.3	3	2.5	15	4.8	
Diabetes mellitus							0.008 <sup>a</sup>
Yes	78	41.3	69	56.6	147	47.3	
No	111	58.7	53	43.4	164	52.7	
Hospitalizations							0.000 <sup>a</sup>
In the same month in which HD started	99	52.4	102	83.6	201	64.6	
1 to 3 months after starting HD	18	9.5	4	3.3	22	7.1	
> 3 months after starting HD	36	19.0	13	10.7	49	15.8	
No hospitalization after starting HD	36	19.0	3	2.5	39	12.5	
THYT (days)							0.852
THYT up to 7,5	95	50.3	60	49.2	155	49.8	
THYT > 7,5	94	49.7	62	50.8	156	50.2	

<sup>a</sup> p < 0.05 Difference between groups tested using the Chi squared test  
HD: hemodialysis; THYT: time spent in hospital/year of treatment

*Albert Einstein Hospital*, and different to that described in studies of the population treated by the SUS. The influence of socioeconomic status on the prevalence of treatment in elderly merits greater detail.

SUS patients in HD had a median monthly income of R\$ 120.00 in 2000 and, in 83% of cases, had not completed primary education.<sup>3</sup> The patterns of income and the educational profile of those with HD incidents using the provider in this study were not examined, as this

information was not recorded in the provider's database. Albuquerque et al<sup>10</sup> (2008) indicated that having a health care plan increased with per capita household income.

Diabetes mellitus was the most common comorbidity in HD patients. Data from America report variable proportions of the presence of diabetes mellitus (from 44%<sup>13</sup> to 58.8%<sup>20</sup>), where as the reported prevalence for Brazil and for the Southeast was 26% in the 2008 SBN Census.<sup>21</sup>

**Table 2.** Cox proportional hazard model with hazard ratios for death by clinic and epidemiological characteristics of hemodialysis patients. Belo Horizonte, MG, Southeastern Brazil, January/2004 to December/2008.

Variable	HR	95%CI (RR)
Age group (years)		
20 to 44	1	–
45 to 64	4.58	1.753;11.984 <sup>a</sup>
65 to 79	6.69	2.595;17.240 <sup>a</sup>
80 and over	12.12	4.546;32.323 <sup>a</sup>
Consultation with nephrologist (months)		
Delayed referral < 4	1	–
Early referral ≥ 4	0.94	0.491;1.807
No consultation	1.94	1.041;3.601 <sup>a</sup>
Diabetes		
No	1	–
Yes	1.55	1.044;2.316 <sup>a</sup>
Hospitalizations		
In the same month in which HD started	1	–
1 to 3 months after starting HD	0.25	0.091;0.714 <sup>a</sup>
> 3 months after starting HD	0.28	0.144;0.548 <sup>a</sup>
No hospitalization after starting HD	0.18	0.052;0.604 <sup>a</sup>

<sup>a</sup> significant variables

Wald test: 84.7  $p = 0.000$

HD: hemodialysis

Analyzing survival, the outcome death was statistically significant for age, diabetes mellitus, first vascular access and being seen by a nephrologist, as observed by other authors.<sup>5,17,23</sup> Among diabetics, the highest number of deaths were observed in the 1<sup>st</sup>, 2<sup>nd</sup> and 5<sup>th</sup> years of treatment compared with non-diabetics and they were at greater risk of this outcome compared with non-diabetics. Similar results were observed in other studies.<sup>11,13,15,16</sup> In 2003, Lopes et al<sup>11</sup> described a higher risk of death in SUS patients among those who had been in HD for less than a year (RR = 1.4) and smaller risk in those who had been in treatment for between three (RR = 0.79) and ten years (RR = 0.88).

The majority of incident patients were seen by a nephrologist before beginning HD treatment (68%). Lee et al<sup>10</sup> (2004) reported that 73.3% of incident patients had been seen by a nephrologist. In the United Kingdom, where consultation with a nephrologist needs to be by referral, this was between 35% and 38%; in Germany, the proportion was 48%<sup>4</sup> and in this study the rate was 10.3%. Around 30% of those with HD incidents had no record of having been seen by a nephrologist before starting HD. This high percentage of patients not being seen by a nephrologist may be related to ignorance of the disease and its evolution,

delaying diagnosis in the initial stages. In this group, a greater risk of the outcome being death was identified (HR = 1.94) when compared with beneficiaries referred later.

The existence of barriers to access may contribute to the rate of patients who are not seen by a nephrologist before starting HD. The rate of incident patients per nephrologist was analyzed, of which 1.6 did not confirm the theory of barrier to access. In England, this rate was 26.5, in Wales 46.1 and in Germany 10.1.<sup>4</sup> Lee et al<sup>10</sup> identified that diabetic patients had a greater chance of early referral to a nephrologist than non-diabetic patients, attributing this result to greater knowledge of the evolution of diabetes and the role of endocrinologists. The performance of health care professional in early referrals to a nephrologist affects the outcome and is well described.<sup>23</sup>

Inadequate preparation for HD is one of the principal consequences of delayed referral and lack of previous evaluation by a nephrologist. One of the most important, with repercussions on the outcome, is the preparation of the arteriovenous fistula. The TVC was the first type of access in 65% of incidents, a pattern similar to that of America (66%) and different to the European results (34%).<sup>24</sup> Changing this pattern of TVC prevalence in the provider is important due to the recognized connection between TVC and longer hospitalizations, the principal cause of infections.<sup>8</sup>

Metcalf et al,<sup>14</sup> (2003) described how the majority of TCRD patients started HD treatment under a regime of hospitalization, a practice considered common, the principal motive being to prepare the vascular access. These hospitalizations were excluded from this study.

Being hospitalized in the same month in which HD was started was associated with death, which may be related to the patients' clinical conditions. However, this is not supported by the provider's database. Longer hospital stays occurred in diabetic patients and in those who used TVC as the first access for HD. The majority of those who were hospitalized in the same month in which HD started (65%) or within three months of starting treatment (72%) remained in hospital for a longer time than those who were hospitalized more than 90 days after treatment started. The link between more advanced age, TVC and diabetes and longer THYT has been described by other authors.<sup>2,14,18,23</sup>

The limitations of this study are those inherent in using an administrative database, thus the lack of socio-economic data, bio-medical measures and causes of CRD. Other variables which are not analyzed in this study may have affected the length of hospitalizations, as none of them were significant in the multiple analysis. Including the patients' clinical and socio-economic data in the provider's database could contribute to widening the analysis of variables

**Tabela 3.** Length of hospital stay per year of treatment and clinical and epidemiological characteristics of patients on hemodialysis. Belo Horizonte, MG, Southeastern Brazil, January/2004 to December /2008.

Characteristic	Length of hospital stay per year of treatment (days)						P
	Up to 7.5 (n = 155)		More than 7.5 (n = 156)		Total (n = 311)		
	n	%	n	%	n	%	
Sex							
Male	86	55.5	87	55.8	173	55.6	0.096
Female	69	44.5	69	44.2	138	44.4	
Age group (years)							
20 to 44	36	23.2	15	9.6	51	16.4	0.010 <sup>a</sup>
45 to 64	52	33.5	57	36.5	109	35.0	
65 to 79	45	29.0	61	39.1	106	34.1	
80 and over	22	14.2	23	14.7	45	14.5	
Time between 1 <sup>st</sup> consultation and 1 <sup>st</sup> HD session (months)							
Delayed referral < 4	16	10.3	16	10.3	32	10.3	0.187
Early referral ≥ 4	97	62.6	83	53.2	180	57.9	
No consultation	42	27.1	57	36.5	99	31.8	
1 <sup>st</sup> vascular access							
Catheter	79	51.0	123	78.8	202	65.0	0.000 <sup>a</sup>
Fistula	61	39.4	24	15.4	85	27.3	
Unknown	15	9.7	9	5.8	24	7.7	
Length of time in treatment (months)							
Up to 12	78	50.3	101	64.7	179	57.6	0.066 <sup>a</sup>
13 to 24	38	24.5	24	15.4	62	19.9	
25 to 36	19	12.3	20	12.8	39	12.5	
37 to 48	10	6.5	6	3.8	16	5.1	
49 to 60	10	6.5	5	3.2	15	4.8	
Diabetes mellitus							
No	101	65.2	63	40.4	164	52.7	0
Yes	54	34.8	93	59.6	147	47.3	
Hospitalizations							
In the same month in which HD started	69	44.5	132	84.6	201	64.6	0.000 <sup>a</sup>
1 to 3 months after starting HD	6	3.9	16	10.3	22	7.1	
> 3 months after starting HD	41	26.5	8	5.1	49	15.8	
No hospitalization after starting HD	39	25.2	0	0.0	39	12.5	

<sup>a</sup> p < 0.05 Difference between groups tested using the Chi-squared test

HD: hemodialysis

related to clinical outcomes of patients with TCRD in HD treatment.

The results found in the cohort of incident patients of TCRD in HD in the provider were close to those obtained in health care systems in developed countries when prevalence and demographic variables such as sex and age are analyzed.

The health care path of patients with CRD in the supplementary health care system has consequences for the outcome. Being seen by a nephrologist and

the first vascular access are stages which determine the success of the chronic renal patient's health care process. Guaranteeing access to health care services within the time necessary should be part of health care managers' strategies. It is not only access which needs to be guaranteed, but also suitable follow up care and the adoption of strategies for the early identification of chronic diseases. Thus, it is necessary to have health care professionals whose knowledge is up to date and public information to guide health care service users in the optimum use of resources

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## HIGHLIGHTS

Between 2004 and 2008, an increase of 160% was observed in the prevalence of chronic renal disease and in the number of patients using renal replacement therapy (RRT) among the clientele of the healthcare plan provider studied.

The indicators of mortality were age, lack of consultation with a nephrologist before starting RRT, diabetes mellitus, short follow-up period, and hospitalization in the same month in which hemodialysis was initiated.

The length of hospital stay per year of treatment did not show a significant association with mortality after controlling for other variables.

Survival rates in the first, second, and fifth years of follow-up were significantly lower in patients with diabetes.

The demographic characteristics of the clientele studied were similar to those of the other centers in Brazil that treat people with health insurance, as well as to those in developed countries.

Studies including clientele of the Brazilian Unified Health System (SUS) showed that the population mainly comprised adults with an average age around 10 to 12 years lower.

The results call for the attention of managers from both public and private healthcare services regarding the importance of offering specialized services and guaranteeing early access to treatment for patients with chronic renal disease.

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