



ORIGINAL ARTICLE

Incidence, prevalence and crude survival of patients starting dialysis in Portugal (2010–16): analysis of the National Health System individual registry

Edgar A. F. de Almeida^{1,2,*}, Mário Raimundo^{1,2}, Anabela Coelho^{3,†} and Helena Sá^{4,†,§}

¹Department of Nephrology, Faculdade de Medicina da Universidade de Lisboa, Lisbon, Portugal, ²Serviço de Nefrologia, Hospital Beatriz Ângelo, Loures, Portugal, ³Comissão Nacional de Acompanhamento da Diálise (CNAD), Direção Geral da Saúde, Lisboa, Portugal and ⁴Department of Nephrology, Centro Hospitalar e Universitário de Coimbra, Coimbra, Portugal

Correspondence to: Edgar A. F. de Almeida; E-mail: edealmeida@mail.telepac.pt

*On behalf of Grupo de Epidemiologia e Prevenção da Doença Renal Crónica (Comissão Nacional de Acompanhamento da Diálise)

†Comissão Nacional de Acompanhamento da Diálise (CNAD), Direção Geral da Saúde

§Former President of the CNAD

ABSTRACT

Background. The Portuguese Society of Nephrology (PSN) reported that Portugal has one of the highest incidences of dialysis in Europe. However, this claim was based on aggregated data supplied by dialysis providers, hampering comparisons between countries. In 2009, an individual registry of patients starting dialysis was set up by the Portuguese Ministry of Health. We analysed individual data of patients starting dialysis from January 2010 until December 2016.

Methods. Demography, starting treatment day, modality, regional distribution and outcomes, such as death, recovery of renal function, transfer to renal transplantation, peritoneal dialysis or conservative management, were extracted. Incidence, prevalence and survival analysis were calculated and compared with the PSN registry.

Results. Out of 19 190 registrations, 16 775 were incident patients (61.8% men). Yearly incidence of renal replacement therapy was 250, 248, 229, 239, 230, 231 and 244 per million population (p.m.p.) for 2010 to 2016, compared with 235, 224, 218, 230, 234, 225 and 239 p.m.p. reported by the PSN registry. On the other hand, prevalence increased from 998 p.m.p. in 2010 to 1286 p.m.p. in 2016, compared with 1010 p.m.p. in 2010 increasing to 1203 p.m.p. in 2016 from the PSN registry. The regions of Alentejo (122.9 p.m.p.) and the the Centre (160.8 p.m.p.) had the lowest regional incidence, while Lisbon had the highest (386 p.m.p. in 2016). Unadjusted survival analysis revealed that 93.5% of the patients were alive on the 91st day, whereas 85.2 and 78.3% were alive at 1 and 2 years, respectively. Crude survival at 7 years was 40%.

Conclusions. For the first time, an individual registry of patients starting dialysis in Portugal was subject to analysis and added new information about long-term survival and regional differences in the incidence and prevalence of renal

Received: 12.9.2019. Editorial decision: 2.1.2020

© The Author(s) 2020. Published by Oxford University Press on behalf of ERA-EDTA.

This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits non-commercial re-use, distribution, and reproduction in any medium, provided the original work is properly cited. For commercial re-use, please contact journals.permissions@oup.com

replacement therapy. We were able to confirm that Portugal has one of the world's highest incidences and prevalences of dialysis. We also demonstrate, for the first time, a striking regional difference in the incidence of dialysis and an excellent early and long-term survival of patients on dialysis. These results compare well with other European countries in terms of the dialysis efficiency.

Keywords: ESRD, incidence, Portugal, prevalence, survival

INTRODUCTION

Portugal has the highest incidence of end-stage renal disease (ESRD) in Europe and one of the highest in the world [1], leading to significant loss in quality of life and imposing economic pressure on the healthcare system. However, the definition of ESRD incidence and prevalence is treatment-based, justifying a gap between biological incidence of ESRD and the starting date of renal replacement therapy (RRT) [2].

Several factors can explain this high incidence and prevalence of ESRD in Portugal, ranging from poor control of risk factors, ageing, late referral to nephrologists and undescribed genetic propensity to chronic kidney disease (CKD), to universal and unrestricted access to dialysis [3].

In 2008, the Portuguese National Health Service (NHS) implemented a new model for integrated management of ESRD, which changed the way that care is provided for dialysis patients. It included a bundle-associated model of payment with the following main features: (i) a weekly payment for a comprehensive amount of services (dialysis treatments, renal medication, vascular access, nephrologist care) per patient; (ii) establishment of quality indicators (laboratory and clinical parameters); (iii) a direct relationship between payment and compliance with established therapeutic goals; and (iv) a patient satisfaction and monitoring evaluation mechanism through a surveillance entity, the National Commission for Monitoring of Dialysis. To support the implementation of this model, an individual online registry directly connected with dialysis units dealing with administrative and clinical data was set up in 2009 [2, 4]. The online registry was intended to report every movement of patients admitted to dialysis, transferred to other RRT or to palliative care, as well as outcomes such as death or recovery of renal function. In Portugal, ambulatory dialysis outside the NHS is negligible and <10% of the patients are treated in public hospitals.

To apply for dialysis treatment within the NHS, incident patients should be referred to nephrology centres in public hospitals that have the ability to register them into the online registry and then, if appropriate, transfer them to the private satellite clinics network. This includes temporary patients. The online registration was approved by the Data Protection Committee of the Portuguese Parliament. Since its implementation, all patients performing ambulatory dialysis should have been registered online.

This study presents the analysis of the online registry data since 2009 aiming to determine the incidence and prevalence of RRT, as well as the survival of RRT patients in Portugal, and to compare the results with the aggregated data from the Portuguese Society of Nephrology (PSN) registry, which is the origin of the data annually sent to the ERA-EDTA Registry.

MATERIALS AND METHODS

The online and PSN registries

The registry of the PSN is obtained by an annual inquiry sent to all nephrology centres, either hospital based or satellite dialysis

units, and its major strengths are its regularity since 1997 and its completeness, as almost 100% of the nephrology centres and dialysis facilities respond each year. On the other hand, the online platform is an individual registry that was set up by the Portuguese Ministry of Health in 2009. This NHS registry [5] captures all patients starting dialysis in the nephrology centres in major hospitals, the majority being transferred to NHS-funded private satellite dialysis units to begin their treatments.

On 6 August 2009, all patients already undergoing chronic dialysis (prevalent patients), whether in satellite units or in public hospitals, were registered. Since then, it became mandatory that all new patients be registered through public nephrology centres, except for patients starting dialysis in the Azores and Madeira regions.

Data in the registry include minimum obligatory information such as full name, gender, birth date and address, as well as the date of the first dialysis and modality of RRT. Although pre-specified, optional information including weight, height, autonomy, viral status, employment, previous referral to a nephrology outpatient clinic, previous use of erythropoietin and vitamin D analogues, was not registered in the majority of the cases so it was not analysed. After registration, patients can start dialysis or renal transplantation, either in a hospital-based centre or in a satellite private unit. Every change is registered, including hospital admissions or transfer to other dialysis facility. Death, transfer to other RRT modality or to palliative care, and interruption of dialysis are also registered as outcomes.

Design and patient selection

We performed a retrospective cohort study analysing the data from the online and the PSN registries between 1 January 2010 and 31 December 2016 confining to patients newly registered in this period.

Extraction of the data from the online registry occurred on 31 January 2017 and was limited to the obligatory admission data. As the online registry was used to permit patients already on dialysis in other countries to be treated while on holiday or travelling to Portugal, we removed all transitory patients from the analysis. Moreover, as the PSN registry includes data from Madeira and Azores, we excluded the data for patients from those islands to allow comparisons with the data from the online registry.

Definitions and statistical analysis

Incidence was calculated yearly dividing new dialysis patients by the at-risk population, according to the results of the National Census in 2011.

Prevalence was calculated dividing the number of patients on treatment in the last day of each year by the at-risk population.

We considered the at-risk population (in the whole country and each region) as the number of living persons, subtracting those already on RRT. Results were compared with those from the PSN aggregated registry [6].

Table 1. Global data for yearly incident patients (2010–16)

	2010	2011	2012	2013	2014	2015	2016	Total
Absolute number, <i>n</i> (PSN registry)	2510	2391	2323	2427	2473	2352	2407	16 883
Absolute number, <i>n</i> (online registry)	2559	2487	2287	2395	2300	2313	2434	16 775
Age, mean ± SD, years	64.4 ± 16.3	64.2 ± 17.3	64.9 ± 16.9	65.3 ± 16.0	65.5 ± 16.0	66.2 ± 15.7	66.1 ± 15.9	65.4 ± 16.3
Gender, male, %	61.7	61.8	60.3	61.7	60.5	62.1	62.3	61.5
Peritoneal dialysis as first RRT, %	2.2	6.6	4.4	4	3.8	5.2	4.8	4.4
Mortality, % ^a	51.3	45	40.3	34.1	28.6	19.7	11	33.1
Mortality first 90 days, %	7.2	6.9	6.6	6.7	6.2	5.8	6.2	6.5
Mortality 365 days, %	16.8	15.6	15.2	15.4	15.1	14.3	–	14.8
Mortality 2 years, %	25.7	23.6	24.4	23.4	23.9	–	–	21.7

^aGlobal mortality (i.e. until the end of study period).

There are five NHS regions in Portugal (North, Centre, Lisbon and Tagus valley, Alentejo and the Algarve) that were comparatively analysed. As per 2016, the North region had 3 584 575 residents (19.5% aged ≥65 years), the Centre region had 2 243 934 residents (23.6% aged ≥65 years), Lisbon and Tagus valley had 2 821 349 residents (21.3% aged ≥65 years), the Alentejo region had 718 087 residents (25% aged ≥65 years) and the Algarve region had 441 469 residents (21.1% aged ≥65 years). Life expectancy at birth varied from 80.99 years in the North region to 80.04 years in the Alentejo region in the 2014–16 triennium and increased slightly, in all regions, from 79 years (whole country) in the 2010–12 triennium. In 2016, the Lisbon and Tagus valley region had the highest gross domestic product (GDP) per capita (€23 768), while the North region had the lowest (€15 316). For the purpose of this analysis, we assumed that registration in the nephrology centre allocated to a specific region means that the patient lives in that region.

Survival analysis was conducted with the Kaplan–Meier method since the first day of treatment and censored for the end of the follow-up, change to another modality of RRT or recovery of renal function. For comparisons with other registries, survival was evaluated at Day 91, the first and second year, and at the end of follow-up.

Groups were compared using Chi-squared test for discrete variables or t-test (if normally distributed) or Mann–Whitney U test (non-parametric) for continuous variables. Double sided $P < 0.05$ was assumed as statistically significant.

RESULTS

Until 31 January 2017, a total of 31 325 registrations were carried out. On 6 August 2009, 10 458 patients were registered and until the end of the year 1447 more were added. On the other hand, 230 registrations were carried out between 1 January and 31 January 2017. Therefore, between 1 January 2010 and 31 December 2016, a total of 19 190 registrations were performed. We removed 2329 transitory (holiday) patients and 86 for several inconsistencies, resulting in 16 775 incident patients for analysis. Table 1 presents registrations per year (2010–16) compared with those presented by the PSN in the same period.

Demography

Out of those 16 775 incident patients, 10 317 were men (61.5%). The oldest patient who started dialysis in this period was 102 years old, and recovered renal function after 6 months.

Women were slightly older than men (66.3 ± 16.5 versus 64.9 ± 17.0 years; $P < 0.01$) (Table 1). Although this difference was

Table 2. Incidence (p.m.p.) of RRT by region

Region	2010	2011	2012	2013	2014	2015	2016
Alentejo	146.7	120.2	120.2	142.7	111.0	142.7	122.9
Algarve	279.6	235.3	155.4	226.4	217.6	244.2	190.9
Centre	210.2	190.9	179.7	178.0	182.7	157.4	160.8
Lisbon and the Tagus Valley	379.1	383.0	356.4	386.6	355.8	360.8	386.7
North	195.0	209.1	192.9	186.9	189.6	195.9	218.4
Portugal (mainland)	250.4	248.2	228.6	239.3	230.0	231.4	243.9
Portugal (PSN registry)	235.0	224.0	218.0	230.0	234.0	225.0	229.0

observed in each year of the period, it did not reach statistical significance except in 2014.

Incidence and point prevalence of RRT

According to the 2011 census, resident population in mainland Portugal was 10 047 621 individuals. Therefore, the incidence of RRT was 250, 248, 229, 239, 230, 231 and 244 per million population (p.m.p.) between 2010 and 2016, compared with 235, 224, 218, 230, 234, 225 and 239 p.m.p. reported by the PSN registry (Table 2).

Yearly regional incidence ranged from 111 p.p.m. in the region of Alentejo in 2014 to 386 p.p.m. in the region of Lisbon in 2013 and 2016.

During the study period, point prevalence of RRT increased from 998 p.m.p. in 2010 to 1289 p.m.p. in 2016 (Table 3). Compared with the PSN registry there was a difference ranging from –17 p.m.p. (in 2010) to +86 p.m.p. (in 2016).

Increasing point prevalence across the period was also observed in all five regions. The region of Lisbon and Tagus Valley had the highest prevalence ranging from 1587 p.m.p. in 2010 to 2055 p.m.p. in 2016. The lowest point prevalence was observed in the region of Alentejo ranging from 655 p.m.p. in 2010 to 750 p.m.p. in 2016.

Haemodialysis was the first modality of treatment in 15 344 patients (91.9%). Peritoneal dialysis was the choice in 746 patients (4.4%), while 21 were registered as choosing pre-emptive renal transplantation. In a considerable number of patients, the modality was either ‘not determined’ (705 patients) or unavailable (12 patients). Conservative treatment was registered for 40 patients.

Outcomes

The majority of patients that started dialysis in this period were alive on 31 December 2016 (9923 patients; 58.8%), whereas 5551

Table 3. Prevalence (p.m.p.) of RRT by region at the end of the year

Region	2010	2011	2012	2013	2014	2015	2016
Alentejo	655.4	676.5	687.1	721.5	713.6	732.1	750.6
Algarve	965.4	1047.6	1081.0	1152.1	1218.8	1316.6	1323.2
Centre	806.1	852.2	876.3	899.1	922.8	926.6	926.6
Lisbon and the Tagus Valley	1587.3	1693.2	1755.1	1864.6	1942.5	1992.7	2055.0
Norte	745.3	823.2	874.8	910.9	952.5	994.6	1039.7
Portugal (mainland)	998.8	1073.1	1117.3	1172.4	1217.4	1253.6	1289.3
Portugal (PSN registry)	1016.0	1052.0	1068.0	1116.0	1159.0	1182.0	1203.0

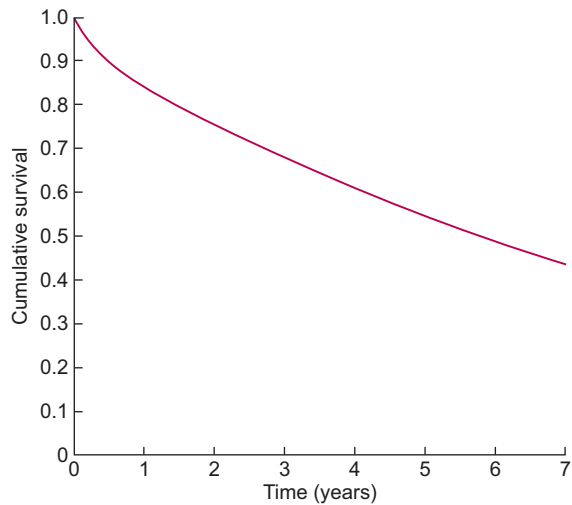


FIGURE 1: Unadjusted survival analysis of patients starting RRT in the period of analysis (2010–16). Data from whole country. Source: Online registry of the National Health Service, Portugal.

Table 4. Comparative survival analysis of two 3-year periods (2010–12 and 2013–15)

	Total	2010–12	2013–15	P-value
n	14 341	7333	7008	
Age, mean \pm SD, years	64.8 \pm 16.5	64.8 \pm 16.8	65.7 \pm 15.9	0.026
Gender, male, %	61.4	61.3	61.4	0.871
Peritoneal dialysis, %	4.3	4.4	4.3	0.938
Mortality Day 90, %	6.6	6.9	6.3	0.102
Mortality Day 365, %	15.4	15.9	14.9	0.116
Mortality 2 years, %	23.5	24.6	22.3	0.001

patients died (33.1%) and 954 (5.6%) were reported as receiving a renal transplant. Only five patients were recorded as changing to peritoneal dialysis after haemodialysis.

Thirty-six patients abandoned dialysis based on personal decision, 47 abandoned for medical decision and 32 were transferred to palliative/conservative care, giving a total of 116 (0.6%) patients interrupting dialysis. On the other hand, 186 patients recovered sufficient renal function to stop dialysis.

In an unadjusted survival analysis, 93.5% of the patients were alive on the 91st day, whereas 85.2% and 78.3% were alive at 1 and 2 years, respectively (Figure 1). More than 40% of patients survived the 7 years period of analysis.

We divided the cohort into two 3-year periods, 2010–12 and 2013–15, to ascertain whether there were any trends in

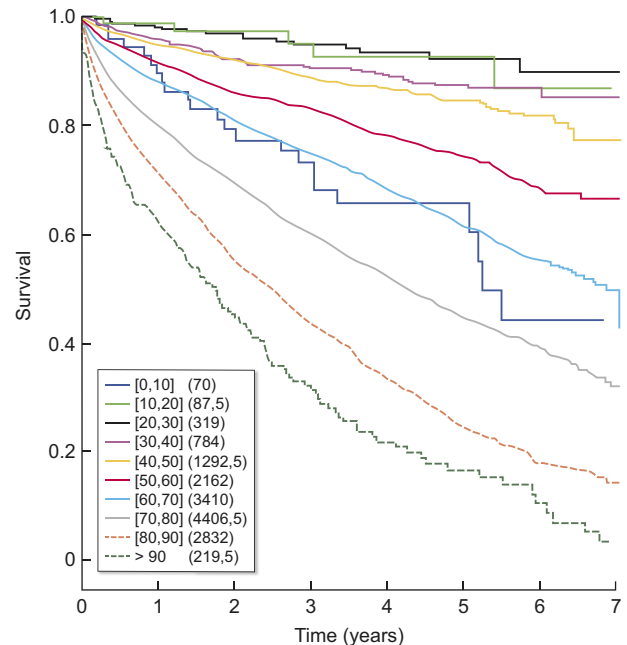


FIGURE 2: Survival as a function of the age at RRT initiation (numbers next to the age group categories represent number at risk at the beginning of follow-up). Data from whole country. Source: Online registry of the National Health Service, Portugal.

population characteristics, RRT initiation or outcomes. A small, but significant, increase in the age of dialysis initiation between these two periods (64.8 \pm 16.8 versus 65.7 \pm 15.9 years; $P = 0.026$) and a significant decrease in the two-year mortality (24.6% versus 22.3%; $P = 0.001$) were observed (Table 4).

A comparative analysis of regional differences showed that the unadjusted survival in the Algarve (95% at Day 91, 86.9% at 1 year and 80.2% at 2 years) was significantly better than in the other regions.

As expected, survival rate decreases progressively as function of age at the beginning of treatment (Figure 2).

DISCUSSION

The online registry of dialysis patients is the only individual registry of patients starting dialysis in Portugal. To date, the available data on the epidemiology of ESRD were those from the PSN registry, which is based on aggregated data. The online registry was designed to enable a detailed record of all movements of patients starting dialysis, such as hospital admissions, changing between modalities and outcomes such as death, recovery of renal function or transfer to palliative care. The online

registry was also set up to ascertain the quality of delivered dialysis and its associated medical care. Therefore, analysis of its data is of surmount importance to find out the real picture of ESRD treatment in Portugal, the country with the highest prevalence and incidence in Europe and one of the highest in the world. As this assumption is based only on the data provided by the PSN registry, it is important to understand the differences between both registries as they were designed for almost the same population.

Our results show that the incidence of RRT in Portugal is one of the highest in Europe and remained steadily above 220 p.m.p. during the whole period of analysis. Compared with the data from the PSN registry, there was a small difference in the RRT incidence ranging from +24 p.p.m. in 2011 to -4 p.p.m. in 2014. However, these differences do not invalidate the core message that Portugal has one of the highest incidences of RRT in Europe.

Our data show a striking regional difference in RRT incidence. The highest incidence was observed in the region of Lisbon and the Tagus Valley (over 350 p.m.p.), while the Alentejo region showed the lowest incidence (around 120 p.m.p.). Although internal migration towards metropolitan areas is a well-known phenomenon in Portugal, it hardly explains a preferential migration of CKD patients that would be needed to account for the higher incidence in this region. On the other hand, Alentejo is a region with a high rate of people aged >65 years of age, who harbour an increased risk for CKD, and thus a high incidence of RRT would be anticipated. Therefore, explanation for these discrepant incidence rates needs further studies.

The reasons for the high incidence of RRT in Portugal are not fully understood. Concerning risk factors, Portugal has one of the highest diabetes mellitus (DM) prevalences in Europe (9.9% of those aged between 20 and 79 years old in 2016) [7], and also a high prevalence of hypertension (42% of the adult population), as well as a high salt intake (almost double the World Health Organization's recommendations) [8], which can contribute to CKD development and progression to renal failure.

In a recent publication [9], European countries were compared on the rate of adequate control of risk factors associated with CKD. The risk factors considered were DM, obesity, high blood pressure, physical inactivity, current smoking and salt intake. An average score of these risk factors demonstrated that Portugal has the highest index of uncontrolled risk factors, followed by Spain. On the other hand, Switzerland had a lower average score of risk factors and also has the lowest prevalence of CKD. However, this does not explain regional differences between and within countries. In fact, even sharing a common demographic background, genetic origin, environmental issues, rate of control of risk factors, GDP and a similar healthcare system, Spain has half the rate of incidence of RRT compared with Portugal. However, the incidence of RRT in Spain varies significantly between regions, ranging from 94.5 p.m.p. in Cantabria to 172 p.m.p. in Asturias (data from 2016) [10, 11], two regions that are in close proximity, which poses serious doubts on the explanations claiming environmental, socioeconomic, dietary or genetic differences.

The socio-cultural characteristics of the Portuguese population, with a low level of health literacy (only 44.2% of adults have a sufficient or excellent level of health literacy) [12], the lack of access to differentiated healthcare (late referral to nephrological care accounts for 25–30% of patients starting dialysis in Portugal) [4] and the public health policies particularly in primary care preventive intervention may also be important

factors to explain the persistent elevated incidence of ESRD in Portugal. It should be borne in mind that a well-distributed private network of dialysis units covering all mainland territory, reducing the distances that patients need to travel from their homes, fully paid for by public funding, increases the accessibility and rates of use of RRT.

Finally, criteria for admission to RRT are not uniform and are subject to personal views, moral and ethical issues. Our data show that conservative or palliative care is an option that is not uniformly used by the different nephrology centres. However, this could be the result of absence or heterogeneity in registration of the patients starting conservative care. Nonetheless, there is an increasing awareness of this option, which is demonstrated by a considerable number of scientific communications and debates in the nephrological community in Portugal [13], anticipating a possible change in this panorama.

In a recent study comparing practices of foregoing of or withdrawal from dialysis between the USA and the UK, the authors found that nephrologists from both countries alluded the absence of guidelines and accurate prognostic tools to inform discussions about foregoing dialysis. Moreover, they considered that it was easier to start dialysis than to have an extended conversation with their patients about both options [14].

Although all these factors could explain the high incidence rate, we should be aware that this rate could be even greater as considerable amounts of patients aged ≥ 65 years with CKD will eventually die before starting an RRT. Santos *et al.* [22] performed a competitive risk analysis in a cohort of 416 patients with CKD (Stage 3 or greater), with a mean follow-up of 3.6 years, and found that 103 (24.8%) died while only 36 (8.7%) progressed to ESRD, meaning that better care will eventually increase the number of patients with ESRD.

Our results show that the prevalence of ESRD was similar to the PSN registry, with minor discrepancies ranging from -17 p.m.p. in 2010 to +86.3 p.m.p. in 2016. An increase in annual point prevalence was observed in all regions.

Increased prevalence is the result of a combination of high incidence and mortality within the expected range. In fact, mortality in the whole Portuguese dialysis population in this period was similar to that reported for European patients. In the first 90 days, 6.5% of patients died, which compares with 6.4% in the ERA-EDTA report [10]. Mortality in the first month after initiation of dialysis is a reflection of the comorbidities and condition of the patients at the beginning of RRT, which means that Portuguese patients starting dialysis are similar to their European counterparts. A lower mortality compared with the European population was observed at 1 year (14.8% versus 15.4%, in the 2010–14 European cohort) and at 2 years (21.7% versus 25.4%) and this can account for increasing point prevalence of RRT in Portugal when compared with other European countries [10, 11]. A higher usage of haemodiafiltration (54% of all patients treated) when compared with 23% in the dialysis outcomes and practice patterns study may contribute to the lower mortality [6, 16].

These results should be framed within overall health indicators in Portugal, which have shown a notable improvement over the last decades [17], namely with a higher life expectancy (81.3 versus 80.9 years) and a lower infant mortality (2.9 versus 3.7/100 000 live births in 2012) when compared with the European Union (EU) [18]. Combining these results with a lower health expenditure (1989 €/per capita, meaning 9% of GDP, versus 2797 €/per capita in the EU, 9.9% of GDP on average)

contributes to the perception that the Portuguese health system is one of the most efficient in Europe [17].

In fact, in the last report of the Eurohealth consumer index (2018), a ranking of countries based on the consumer viewpoint regarding the way that consumers evaluate several items such as Patient Rights and Information, Access to Care, Treatment Outcomes, Range and Reach of Services, Prevention and Use of Medications, Portugal is very well positioned, in the merge of the 800 points club, which means that people feel that the access to the healthcare system compares well with other European countries. Concerning kidney transplants per million population, Portugal is among the top countries in Europe (7th position), whereas it is only in 22nd position with respect to home dialysis. As a result, we can conclude that people have good access to healthcare, but renal care is insufficiently powered in the interaction with healthcare professionals meaning that we need to improve the knowledge on CKD within healthcare professionals.

In the area of RRT this efficiency is acknowledged, as the outcomes reported are in line with the best international results (annual mortality rates <14%) and associated with reduced costs per patient (<22 500 €/patient per year) [4, 18–21]. The disparity between RRT incidence and GDP per capita in Portugal strengthens the little overall correlation between RRT incidence and GDP per capita in Europe [22, 23].

The authors are aware that this analysis has several limitations: first, unavailability of estimated glomerular filtration rate (eGFR) at the beginning of treatment is a major drawback of this analysis as higher incidence and better survival are expected in patients with higher eGFR, and this is an opportunity for further investigation in this subject; secondly, sufficient clinical information, particularly on comorbidity and causes of renal disease, is not available to enable for adjustments in the rate of incidence, prevalence and survival; thirdly, we feel that, besides haemodialysis, registrations of patients for other modalities such as peritoneal dialysis, pre-emptive renal transplantation or palliative care may be incomplete, limiting the scope of this analysis; fourthly, changing between modalities may not be adequately registered in the online platform; finally, data on the platform were not subject to an auditing process and although intentional misinformation is hardly expected, mistakes can occur. However, the small differences between the online and PSN registries validate the accuracy of both.

CONCLUSION

For the first time, an individual registry of patients starting dialysis in Portugal was subject to analysis and confirms, in broad terms, the results of the PSN aggregated registry, which corroborates that both registries are credible.

The current analysis added new information about long-term survival and regional differences in incidence and prevalence of RRT. These results compare well with the quality of dialysis that is provided in other European countries and, in this regard, the Portuguese healthcare system should be acknowledged for its efficiency in terms of balance between expenditure and outcomes.

On the other hand, the high incidence of dialysis should be addressed by implementing measures to control CKD risk factors early in the natural history of the disease, which should involve primary care physicians as well as other specialists such as cardiologists and endocrinologists.

SUPPLEMENTARY DATA

Supplementary data are available at ckj online.

ACKNOWLEDGEMENTS

The authors wish to thank the Administração Central dos Serviços de Saúde and the Direção-Geral da Saúde (National Health Board) for giving permission to the study.

CONFLICT OF INTEREST STATEMENT

E.A.F.d.A. received a lecture fee from Vifor Pharma.

REFERENCES

1. United State Renal Data System. www.usrds.org (21 August 2018, date last accessed)
2. Anand S, Bitton A, Gaziano T. The gap between estimated incidence of end-stage renal disease and use of therapy. *PLoS ONE* 2013; 8: e72860
3. Robinson BM, Akizawa T, Jager KT et al. Factors affecting outcomes in patients reaching end-stage renal disease worldwide: differences in access to renal replacement therapy, modality use, and hemodialysis practices. *Lancet* 2016; 388: 294–306
4. Coelho AP, Sá HO, Diniz JA et al. The integrated management for renal replacement therapy in Portugal. *Hemodial Int* 2014; 18: 175–191
5. Plataforma Gestão Integrada da Doença. <http://gid.min-saude.pt> (24 August 2018, date last accessed)
6. http://www.spnephro.pt/tratamento_da_doenca_renal_terminal/2018 (25 November 2018, date last accessed)
7. OECD. *Health at a Glance 2017: OECD Indicators*. Paris: OECD Publishing, 2017. 10.1787/health_glance-2017-en (19 November 2018, date last accessed)
8. Polonia J, Martins L, Pinto F et al. Prevalence, awareness, treatment and control of hypertension and salt intake in Portugal: changes over a decade. The PHYSA study. *J Hypertens* 2014; 32: 1211–1221
9. Stel VS, Brück K, Fraser S et al. International differences in chronic kidney disease prevalence: a key public health and epidemiological research issue. *Nephrol Dial Transplant* 2017; 32: ii129–ii135
10. Annual Report. www.era-edta-reg.org, 2016 (25 November 2018, date last accessed)
11. http://www.euro.who.int/_data/assets/pdf_file/0007/337471/HiT-Portugal.pdf (10 November 2018, date last accessed)
12. Pedro AR, Amaral O, Escoval A. Literacia em saúde, dos dados à ação: tradução, validação e aplicação do *European Health Literacy Survey* em Portugal. *Rev Port Saú Púb* 2016; 34: 259–275
13. Norma 017. Tratamento Conservador Médico da Insuficiência Renal crónica Estádio 5. 2011. <https://www.dgs.pt/normas> (21 August 2018, date last accessed)
14. Grubs V, Tuot DS, Powel NR et al. System-levels barriers and facilitators for forgoing or withdrawing dialysis: a qualitative study of nephrologists in the United States and England. *Am J Kidney Dis* 2017; 70: 602–610
15. Santos J, Fonseca I, Malheiro J et al. End-stage renal disease versus death in a Portuguese cohort of elderly patients: an approach using competing event analysis. *J Investig Med* 2017; 65: 1041–1048
16. Locatelli F, Karaboyas A, Pisoni RL et al. Mortality risk in patients on hemodiafiltration versus hemodialysis: a 'real-

- world' comparison from the DOPPS. *Nephrol Dial Transplant* 2018; 33: 683–689
17. Bjornberg A. Eurohealth Consumer Report, 2018. <https://healthpowerhouse.com/media/EHCI-2017/EHCI-2018-report.pdf> (29 November 2019, date last accessed)
 18. https://ec.europa.eu/info/sites/info/files/file_import/aar-estat-2016_annex_en_0.pdf (10 November 2018, date last accessed)
 19. Ponce P, Marcelli D, Guerreiro A *et al.* Converting to a capitation system for dialysis payment—the Portuguese experience. *Blood Purif* 2012; 34: 313–324
 20. Dor A, Pauly MV, Eichleay MA *et al.* End-stage renal disease and economic incentives: the International Study of Health Care Organization and Financing (ISHCOF). *Int J Health Care Finance Econ* 2007; 7: 73–111
 21. Vanholder R, Davenport A, Hannedouche T *et al.*; on behalf of the Dialysis Advisory Group of the American Society of Nephrology. Reimbursement of dialysis: a comparison of seven countries. *J Am Soc Nephrol* 2012; 23: 1291–1298
 22. Heaf J. Current trends in European renal epidemiology. *Clin Kidney J* 2017; 10: 149–153
 23. Kramer A, Pippias M, Stel VS *et al.* Renal replacement therapy in Europe: a summary of the ERA-EDTA Registry Annual Report with a focus on diabetes mellitus. *Clin Kidney J* 2016; 3: 457–469