

Chronic kidney disease burdens the cost of patients in four hospital centers: Panamá, 2024

Costo de carga de enfermedad renal crónica de pacientes en cuatro centros hospitalarios: Panamá, 2024

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Received 14 enero 2026

Accepted 18 marzo 2026

DOI: <https://doi.org/10.48204/societas.v28n2.9498>

Abstract

The objective of our research is to estimate the cost of chronic kidney disease in patients at four Social Security Administration hospitals. We estimated the years of life lost due to premature death adjusted for disability using a social discount rate of 3% valued by average income. Out-of-pocket expenses were calculated using the socioeconomic survey. Three indices were estimated using factor analysis with the quality-of-life survey, and hospital costs were projected to 2030 based on an annual increase in patients of 2.5%, 5%, and 10%. The average number of years of life lost due to disability was 7, with a total value of USD 28,680.15, while for deceased patients, the average was around 12 years, valued at more than USD 7,000.00. Seventy-seven percent of patients experience the risk of catastrophic expenditure. The factor indices show a loss in quality of life related to work activity, daily tasks, social relationships, and emotional state. There is strong pressure on hospital costs as social dependence on CKD treatment increases, based on the annual increase in patients of 10%. By 2030, the estimated cost would be USD 32,081,828.72, compared to the 2023 baseline of USD 16,463,050.85. Given these scenarios, the focus on CKD prevention, especially the role that primary care should play, is crucial.

Keywords: chronic kidney disease, quality of life, hospital costs, out-of-pocket expenses, Panamá.

Resumen

El objetivo de nuestra investigación consiste en estimar el costo de carga de enfermedad renal crónica de pacientes en cuatro centros hospitalarios de la Caja del Seguro Social. Se estimaron los años de vida perdidos por muerte prematura ajustados por discapacidad con una tasa social de descuento del 3% valorizados por el ingreso medio. El del gasto de bolsillo se

realizó con la encuesta socioeconómica. Se estimaron tres índices mediante análisis factorial con la encuesta de calidad de vida y se realizó una proyección de los costos hospitalarios al 2030 mediante incremento anual de pacientes en 2.5%, 5% y 10%. El promedio de años de vida perdidos por discapacidad fue de 7, con un valor total de USD 28,680.15, mientras que, para los pacientes fallecidos, el promedio fue en torno a 12 años, valorizados en más de USD 7,000.00. El 77% de los pacientes experimenta el riesgo de gasto catastrófico. Las índices factoriales evidencian una pérdida en la calidad de vida relacionada con la actividad laboral, tareas cotidianas, relaciones sociales y estado emocional. Existe una fuerte presión sobre los costos hospitalarios al aumentar la dependencia social en el tratamiento de la ERC, en base al incremento anual en pacientes en 10%. Para el año 2030 el costo estimado sería de USD 32,081,828.72, respecto de la línea de base de 2023 con USD 16,463,050.85. Frente a estos escenarios el enfoque en la prevención de la ERC, en especial el papel que debe jugar el nivel de atención primaria resulta crucial.

Palabras clave: enfermedad renal, calidad de vida, costos hospitalarios, gasto de bolsillo, Panamá.

Introduction

Chronic non-communicable diseases (NCDs) have become the leading causes of death globally, with chronic obesity, high blood pressure, diabetes and chronic kidney disease (CKD) among the leading causes (Rico Fontalvo, Daza-Arnedo, Montejo Hernandez, Cardona Blanco, & Rodríguez Yanez, 2022). Its impact on the productivity and budgets of the public health sector is of great magnitude and a social and economic burden for patients and their families (Navarro González et al., 2024).

In Panama, CKD ranks fourth with a rate of 32.18 deaths per 100,000 inhabitants, being above the global average with 19.36 (Evaluation, 2022). There are many risk factors involved in this disease, such as diabetes, high blood pressure, environmental factors, obesity or exposure to toxic products, among others, linked to lifestyles and working conditions in certain areas of the country (Jan Carmen et al., 2014; Moreno

Velásquez et al., 2019; Quiel, Moreno Velásquez, Gómez, Motta, & Herrera-Ballesteros, 2019).

According to the most recent estimates in the case of Panama for the year 2015, the joint global cost (public and private sector) of peritoneal dialysis and hemodialysis totaled USD 70,351,301.23, while the economic estimate of the years of life lost due to premature death (YLL) was USD 25,501,808.40, representing a high cost of disease burden without taking into account the years of life lost due to disability before death (DALYS) and the direct and indirect costs of patients and their families (Moreno-Prieto, Otálora-Montalvo, Castro, Vargas-Brochero, & Sanabria-Arenas, 2020; Moreno Velásquez et al., 2019).

The worrying thing about this disease is that mortality expresses an inverse demographic transition, as it is affecting the young population from 25 years of age, and the adult population up to 65 years of age, that is, at working age points, according to the International Classification of Diseases ICD-X 085-086 (Censo, 2021). This situation has important socioeconomic implications with respect to the social gap in health, especially because of its significant impact on the country. For 2021 alone, 790 deaths were reported (Censo, 2021).

The lack or scarcity of studies, survey and publication of systematized data at the regional or subnational level is one of the institutional weaknesses, which do not allow obtaining more detailed information that allows to approximate the financial impact in the areas where an increase in this disease is observed not only but also with respect to the estimation of needs. as is the case of the four health facilities that serve this patient population in a focused manner, which imply strong financial pressures on the selected care centers, namely, the Rafael Esteves Hospital in Agua Dulce, the Santiago Barraza polyclinic in La Chorrera, the Ezequiel Abadía de Soná Hospital and the Arnulfo Arias Madrid Hospital Complex in Panama City, all belonging to the Social Security Fund (Iregui-Bohórquez, Pinilla-Alarcón, Melo-Becerra, & Ramírez-Giraldo, 2023).

These centers serve a demand for patients who are dialyzed three times a week, in rooms that operate 24 hours a day, seven days a week, in addition to the fact that the out-of-pocket expense that falls on the care of insured patients, can leave them at risk of poverty due to the loss of their jobs or significant reduction in their labor productivity in addition to the costs that fall on their family members, which generate an economic cost of disease burden on society as a whole, especially when this disease affects the heads of the family (Arredondo Pantaleón & Jurado Cárdenas, 2021; Crews et al., 2020)

Materials and methods

The statistical information used comes from two sources, the first refers to the monthly information on hospital costs of hemodialysis treatment, summarized in the following items:

1. Human resources (specialists, nurses, nutritionists, etc.) 2. Patient transport and feeding 3. Accommodation of patients and relatives 4. Equipment, maintenance, and repair 5. Use of equipment 6. Materials and supplies 7. Medications 8. Laboratory tests 9. Medical and surgical equipment 10. Any other relevant cost information that the entity considers indispensable.

The second source of information comes from the application of two patient surveys for the calculation of life years lost due to disability and the records of deaths for the calculation of life years lost due to premature death adjusted for disability.

The target population is diagnosed CKD patients, who had a treatment appointment in the dialysis rooms of the Rafael Esteves de Aguadulce, Arnulfo Arias Madrid Hospital Complex, the Ezequiel Abadía de Soná Hospital and the Santiago Barraza Polyclinic in La Chorrera, in the care shifts from 6 a.m. to 6 p.m. during a working week until the sampling quota is completed. Patient selection consisted of the sampling technique with replacement based on patient availability according to inclusion and exclusion criteria.

The sample size was calculated taking into account the number of patients who are treated daily at the established time and surveyed simultaneously in each hospital. (Daniel, 2002; Saavedra Conde, Ordóñez Hernández, Granja Escobar, & Castro Hernández, 2021).

The sampling formula for finite populations used was as follows:

$$n = \frac{NZ^2P_y(1-P_y)Deff}{N\varepsilon^2 + Z^2P_y(1-P_y)Deff} \quad (1)$$

and the correction factor:

$$n = \frac{\varepsilon}{1 + \frac{\varepsilon}{N}} \quad (2)$$

N=Population Size (727)

(ε)=Sampling error (5%)

(P)=Success Rate (18%)

(1-P) =Failure Ratio (82%)

(Z)=Value for Trust (1.96)

Deff=Design effect (1)

For (P), the prevalence of 18% (Marquínez, 2024).

The sample was distributed proportionally according to the number of patients treated in the shifts from 6:00 a.m. to 6:00 p.m. of the four hospitals, in this case 727. Although the correction factor yielded a sample size of 140, it was decided to survey the resulting 172 patients, which represent 24% of all patients. The two forms were applied to each patient according to the inclusion and exclusion criteria approved in the research protocol by the Institutional Research Ethics Committee of the Social Security Fund.

Inclusion Criteria

Patients over 18 years of age agree to take part in the research with the signing of the informed consent who receive hemodialysis treatment.

Exclusion Criteria

Patients over 18 years of age who are not in physical condition such as visual, auditory, or mental limitation to answer the questionnaire.

Hospitalized patients

The calculation of the years of life lost due to premature death adjusted for disability was made with the following general formula:

$$DALYS=YLL+YLD$$

$$YLL=AD-LE$$

Where: YLL = Years of life are those lost due to premature death.

AD: Age of death.

LE: Life expectancy at birth.

In relation to the calculation of the years lived with disability, the calculation is as follows:

$$YLD=AD-AOD$$

Donde: YLD = Years of life lived with disability.

AD: Age of diagnosis of the disease.

AOD: Age of death.

Once the DALYS are projected at net present value using the following formula:

$$\sum_{t=1}^n \frac{DALYS}{(1+r)^n}$$

Where is the social discount rate. In this case, the rate of 3% is used, which is the recommended rate for this type of study (Campos et al., 2016; Health, 2017). Once the DALYS is calculated at present value, they are valued in monetary value by multiplying them by the average income per inhabitant of USD 600.00 (Censo, 2023).

Quality of life indices were calculated using the principal component factor analysis technique with the quality-of-life survey of the KDQOL form. The first refers to the health status index, based on the questions in the first block, with respect to the current assessment of health that covers questions 14 to 24. The second index that refers to the CKD assessment index, referring to the second block of questions referring to the self-assessment of CKD, which includes questions 25 and 26 and the third index that refers to the assessment of the effect of CKD on life, which covers the third block of questions referring to the effect of CKD on life, which goes from question 27 to 38.

The KDQOL or quality of life survey is a qualitative measurement tool that attempts to measure the effect or impact of CKD on patients' physical and mental well-being. This tool therefore consists of a set of qualitative variables, either dichotomous or polytomous, depending on the case, to obtain information on the factors that affect patients' perception of their health (Dehesa Lopez, 2017).

Out-of-pocket expenditure was carried out based on the socioeconomic survey that collects various direct and indirect expenses of the patients, and based on these data, the catastrophic expenditure was calculated under the criterion that it had a percentage greater than or equal to 30% of the individual's income.

There is no single criterion to determine the threshold to consider when an individual is at risk of catastrophic expenditure, but based on previous studies, it is established that when health expenditure is greater than 30% of income, the individual is at risk of catastrophic expenditure on health (Giménez, Flores, Rodríguez, Ocampos, & Peralta,

2018; Herrera-Ballesteros, Castro, & Gómez, 2018; Herrera Ballesteros 2023; Villegas Yarleque, Carrasco Choque, Hidalgo Armestar, & Villegas Aguilar, 2021).

Regarding the projection of hospital costs, it was carried out by consolidating all the cost items for which information could be obtained in each hospital center, and three hypotheses of annual increase in patients were handled, namely 2.5%, 5% and 10%, being very conservative scenarios, considering as a criterion that from 1990 to 2021 the percentage variation of the years of healthy life lost due to CKD was 3.1% as the most recent data (Evaluation, 2022).

Results

Table 1 shows the economic valuation of the years of life lost due to disability using the average income of the patients. In the case of men, the average is lower with USD 28,262.27 in relation to women, USD 29,642.25, being above the general average with USD 28,680.15.

By age groups, the highest concentration in productive ages between 30 and 69 years of age stands out, which are active working ages and can be a sign of reverse epidemiological transition and imply a high opportunity cost due to the hypothetical income not received.

Table 1.

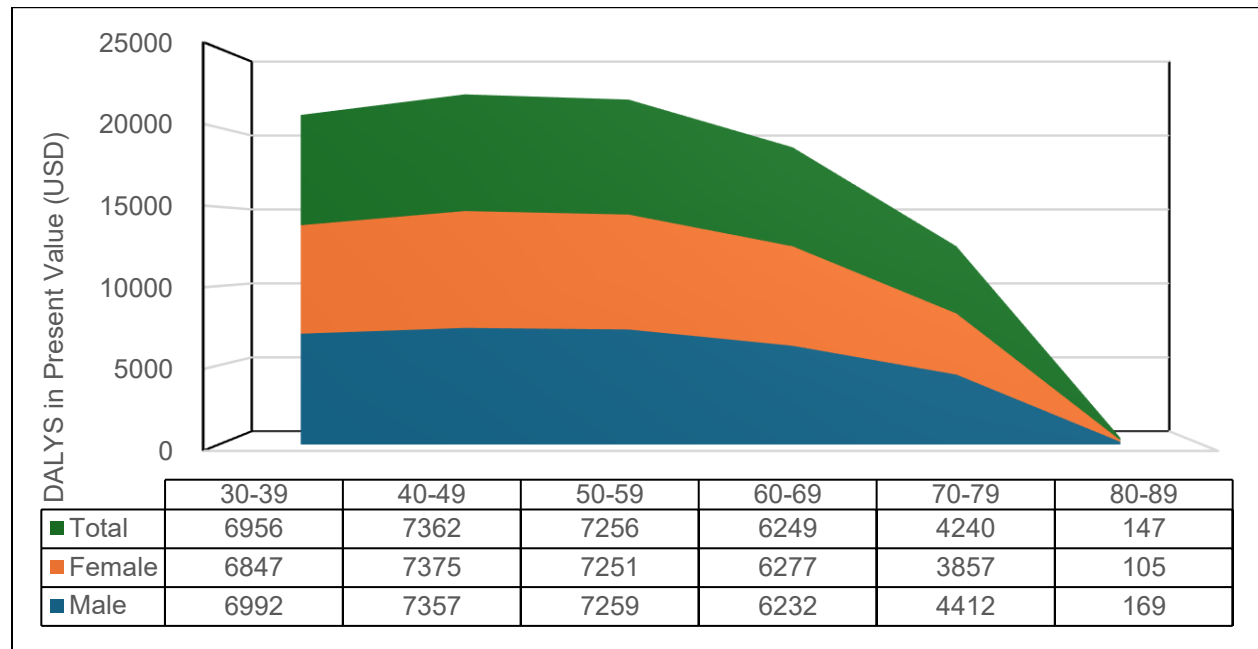
Distribution of years of life lost due to disability in chronic kidney disease of patients according to sex and age ranges.

Ages	Male		Female		Total	
	Total	In USD	Total	In USD	Total	In USD
20-29	4	35 454.36	1	5 463.97	5	29 456.29
30-39	12	32 169.44	6	17 271.31	18	28 976.98
40-49	21	39 347.40	9	55 906.27	30	43 168.68
50-59	26	26 519.18	23	10 887.88	49	21 171.63
60-69	30	23 523.72	18	31 893.88	48	25 884.53
70-79	10	18 330.36	8	51 123.44	18	32 677.33
Eighty and over	2	14 359.45	2	15 830.97	4	15 095.21
Total	105	28 262.27	67	29 642.25	172	28 680.15

In Graph 1, these data were projected valued by the average monthly income of USD 600.00 annualized (Censo, 2023), As one might expect, the highest value is observed in the age groups between 30 and 59 years, with the highest density and cost pressure on patients and the social security system. It has seen that the years valued exceed more than USD 6,000.00 from the 30-39 age group, up to more than USD 7,000.00 in the 50-59 age group.

Figure 1.

Average years of life lost due to disability-adjusted premature death of deceased Patients by age groups. 2023-2024



Source: Hospital patient records.

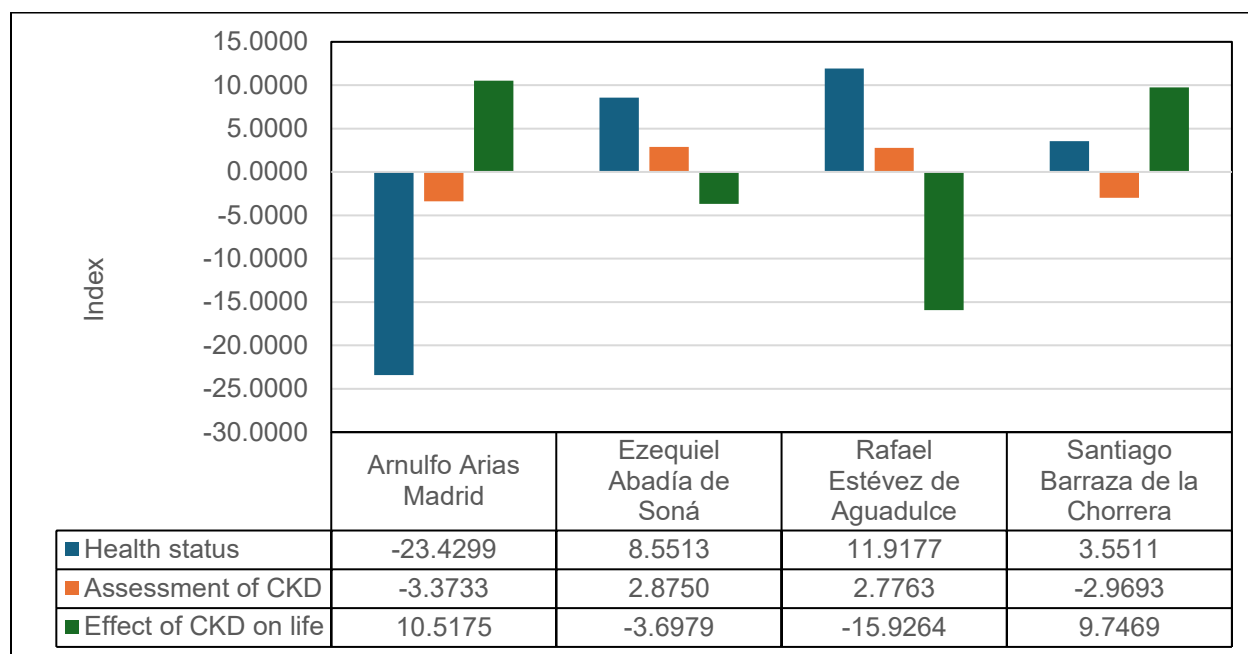
This fact reflects the progress that CKD has made, and its pressure on public budgets, in the face of a weakened health system and the need to promote prevention at the first

level of care in the face of the heavy expenditure involved in the third and fourth levels of care.

Figure 2 shows the distribution of the indices with respect to the patients attending each hospital. The feeling is more negative with respect to the greater impact on daily tasks, which involve physical effort, as well as mood and social relationships.

Figure 2.

Factorial index of perception of the state of health of patients with chronic kidney disease



Source: KMO Statistic 0.84 for the first index, 0.64 for the second index and 0.56 for the third. Quality of Life Survey (KDQOL).

When looking at the results by hospital, the lowest feeling is seen in the health status index, in patients who attend the Arnulfo Arias Madrid Hospital Complex (-23.4299), and the best feeling is seen in the Rafael Estévez Hospital (11.9176). Regarding the assessment index of CKD, the lowest perception is observed in patients who attend the

Arnulfo Arias Madrid Hospital Complex (-2.9693) and the highest in the Ezequiel Abadía hospital (2.8749), while, in relation to the assessment index of the effect of CKD on life, the lowest perception is observed in patients who attend the Rafael Estévez hospital (-15.9263) and the best or highest in the Arnulfo Arias Madrid Hospital Complex with 10.5175.

Table 2 presents the estimate of catastrophic health expenditure that includes items involved in patient care, from medical consultation expenses, medicines, and the coordination involved in their care, etc.

There is no single criterion to determine the threshold to consider when an individual is at risk of catastrophic expenditure, but based on previous studies, it is established that when health expenditure is greater than 30% of income, the individual is at risk of catastrophic expenditure on health (Giménez et al., 2018; Herrera-Ballesteros et al., 2018; Herrera Ballesteros 2023; Villegas Yarleque et al., 2021)

Table 2.

Distribution of patients with chronic kidney disease by the relative share of health expenditure over monthly income, according to hospital

Hospital	Out-of-pocket expense					
	Catastrophic		Non-catastrophic		Total	
	Patients	%	Patients	%	Patients	%
Arnulfo Arias Madrid	31	68.9%	14	31.1%	45	100.0%
Ezequiel Abadía de Soná	7	77.8%	2	22.2%	9	100.0%
Rafael Estévez de Aguadulce	25	67.6%	12	32.4%	37	100.0%
Santiago Barraza	41	93.2%	3	6.8%	44	100.0%
Total	104	77.0%	31	23.0%	135	100.0%

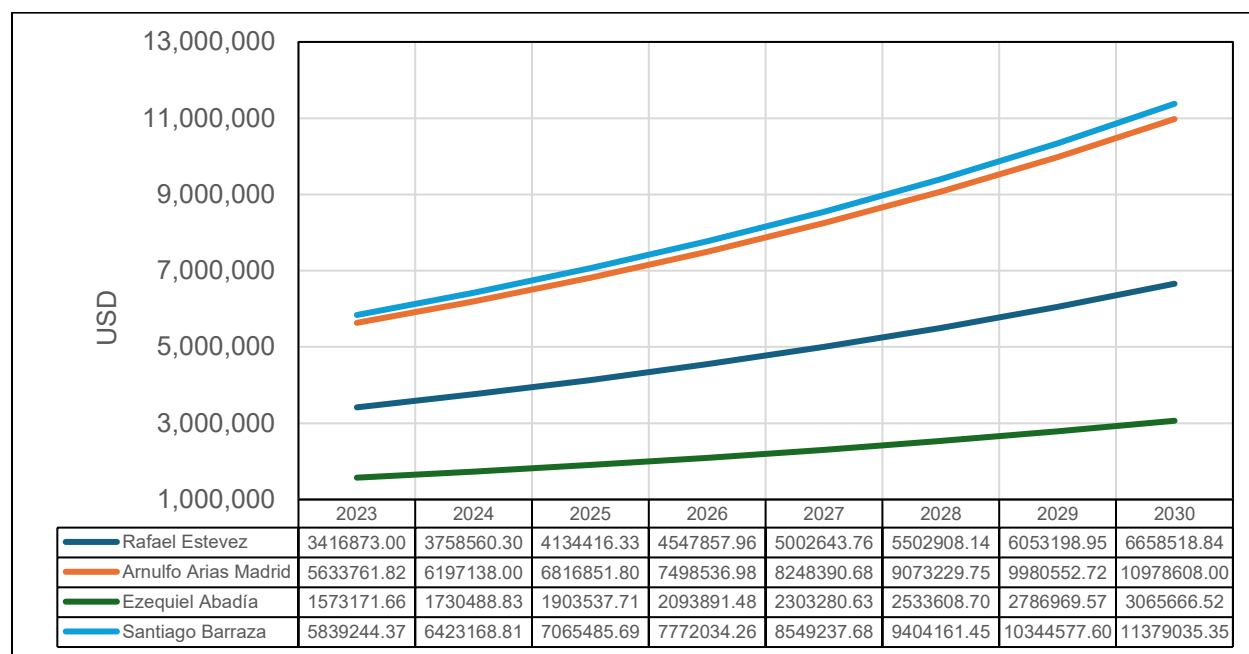
Around 77.0% of patients are at risk of catastrophic health expenditure. In general, the risk of catastrophic health expenditure is present in all hospital facilities, but the most critical case is in the Santiago Barraza polyclinic in La Chorrera with 93.2% of patients.

These results allow us to consider that CKD patients treated in these four hospital facilities are at risk of catastrophic expenditure. It clearly is an excessive cost of disease burden when considering the years of life lost due to disability.

Graph 3 projects the increase in hospital costs based on the cumulative progression of the 10% increase in patients, which leaves a clear perspective of the behavior of costs for the end of the current five-year period.

Figure 3.

Simulation of an increase in hospital costs for CKD patients, 2023-2030



Source: Data provided by hospitals

It remains to be noted that an increase of more than 10% in the number of patients would imply committing huge resources from the Social Security Fund to ERC alone, since the

projection of an increase for 2030 would be USD 32,081,828.72, compared to the 2023 baseline of USD 16,463,050.85.

Considering these results, there is no doubt about the high opportunity cost and budgetary pressure that CKD represents for these hospitals, in which the problem revolves around the acquisition of medicines, supplies and medical-surgical material, among others, characterized by high costs on the one hand and supply problems on the other. They can put the operation of renal replacement therapy rooms in a critical situation, taking into consideration that the number of nephrologists in the country is limited, as well as nurses.

This emphasizes the need to strengthen prevention at the first level of primary care and to make enormous efforts to reverse these trends that can compromise health care not only for patients with CKD, but also for other chronic diseases.

Discussion

CKD represents an enormous challenge for Panama's healthcare system (Censo, 2021). First, the risk of catastrophic spending for the patient and their family must be considered, which can lead to poverty in any household. It can be assumed that having or not having social security or even private coverage is a determining element in the probability of falling at such a risk. However, 77% of those interviewed report being at risk of catastrophic spending despite being insured patients. This situation contributes to widening the gap of inequity in access to health (Crews et al., 2020; Ramos Vázquez, Sánchez Orta, Ramos Vázquez, & Sánchez Orta, 2019).

Another aspect to highlight is the years lived with disability reported by the interviewed patients, which in general range between 5 and 9 years maximum, while in the case of deceased patients they were between 10.4 and 11.6 in the age ranges of 30-39 and 60-69, respectively. These are clearly working ages and leave evidence of an inverse demographic transition, since CKD is being anticipated at very early ages, clearly evidencing years of lost labor productivity (Moreno Velásquez et al., 2019).

The disability caused by CKD also affects the quality of life of patients, making clear physical and psychological limitations in patients' social and work relationships. This implies that the treatment of this disease involves not only health personnel but also the family environment, for a better quality of life for the patient (Arredondo Pantaleón & Jurado Cárdenas, 2021; Ashqui Moreira & Ramírez López, 2021; Saavedra Conde et al., 2021).

That is why attention to risk factors for CKD, such as the prevention of high blood pressure, diabetes, chronic obesity and environmental factors, is of crucial importance, beyond their social determinants (Arias Gonzáles, 2021; García-Trabanino et al., 2017; Quiel et al., 2019).

Clearly, prevention is the cornerstone of the system to avoid an explosive increase in hospital costs in addition to out-of-pocket expenses, which are usually very high in rural areas (Herrera-Ballesteros et al., 2018; Villegas Yarleque et al., 2021).

In the face of an aging population and an inverse demographic transition of CKD, a new health policy approach is essential, which on the one hand focuses on prevention and reduces the high cost of disease burden for patients, on the other (Al-Hemoud, Gasana, Al-Dabbous, Al-Shatti, & Al-Khayat, 2018; Huang et al., 2018; Lelieveld, Haines, & Pozzer, 2018).

Conclusion

This research has revealed part of the reality that patients experience out-of-pocket spending and quality of life, as well as the financial pressure on hospital costs.

The intense pressure of catastrophic expenditure has been shown, even though these are insured patients, especially in the elderly population since it is the most vulnerable stage of life once their active working life ends. Of the patients interviewed, 41% said that they were not retired or pensioned.

The average number of years lost due to disability was 7, both in men and women, but it varies according to the age group, being more important among the age groups between 40-49 (9) and 50-59 (8), as they are working age groups, which represents a high opportunity cost in lost productivity and an economic burden for the public health system.

This aspect was considered in the calculation of the years lost due to premature death adjusted for the years lived with disability in deceased patients. Calculated in present value, its most significant impact was observed in the age groups of 30-39 (11.59), 40-49 (12.27) and 50-59 (12.09), being the highest density reached at working age groups (Censo, 2023).

This makes clear its high impact on catastrophic spending, in which 77% of those interviewed experience a percentage equal to or greater than 30% of their annual income. This situation is of great concern because it leaves these patients and their families in a situation of social risk in addition to the deterioration of their quality of life.

According to the index of perception of the state of health, a negative impact was evidenced, with respect to the performance of daily tasks that involve a relative level of effort, at home, in the environment or at work, as well as in relation to the psychological and emotional part, with respect to moods and social relationships. which becomes an obstacle in the treatment of this disease.

In addition, the pressure on hospital costs is the last element to consider, while for all three scenarios estimated for each of the hospitals it reflects a significant increase at the end of the current five-year period, with an imminent doubling.

This study has represented an effort to highlight the problem of CKD at a subnational level, having chosen four hospitals in four different health regions, but with a similar problem.

Conflict of interest

The authors state that they have no conflict of interest in the development of this research. This research was funded with the public research funds of the State University of Panama. The code of the funds is: code CUFI-2023-CEA-P-009 and registered with the code of the Vice-Rectorate for Research and Graduate Studies: VIP-01-12-2024-01.

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