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# Ethical principles of renal therapy rationing in Senegal

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## Abstract

**Background:** Since 2012, Senegal has conducted a national program to cover renal therapy (dialysis) expenses in public hospitals and social security-approved centers. Given the increasing demand for dialysis, national guidelines recommend explicit rationing through waiting lists, and hospitals have committees to determine whom to enroll. While national recommendations are known, criteria applied in hospitals to register patients remain unclear. Our study analyzes social justice principles used to ration renal therapy in government-owned centers and highlights inequalities caused by low access to treatment.

**Methods:** We conduct a multivariate logit regression analysis using data collected from patients in public and private centers to identify which socioeconomic or sociodemographic factors determine enrollment. Based on the average marginal effects of these factors on program enrollment, we hypothesize the justice principles applied (or not) in hospitals.

**Results:** We find that the duration of illness, insurance distribution, age, education, and involvement in patient associations influence program access. The duration of illness is the most robust predictor regardless of socioeconomic factors, which suggests the predominant application of egalitarian principles, notably the first-come-first-served rule. However, our findings indicate that the most impoverished patients do not have access to free dialysis.

**Conclusions:** Although the national dialysis program aims to improve access to costly life-sustaining treatment, the first-come-first-served strategy is designed to suit patients who live longer, that is, those who can seek dialysis care in a private center. The program does not address inequalities in access, especially for the most impoverished patients recently diagnosed with end-stage kidney disease.

**Keywords:** Free health care policy, Rationing, Social justice theories, Renal therapy, Inequalities

**JEL Classification:** A13, I18, D00, D63

“It has often been said that it is as pointless to fight against injustice as it is to fight against death, but precisely, the central idea of any social justice theory is that injustice is not a fact of nature: it is a human institution.”

*Jean-Fabien Spitz.*

*Translated from French by the authors.*

## Background

Authors agree on the inevitability of rationing medical care either in rich or resource-poor contexts. However, rationing is undoubtedly more critical in developing countries due to the low budget share dedicated to the health sector. Rationing occurs at any health system level, from policymakers who allocate budgets to patients who decide not to seek healthcare for financial reasons. Rationing is induced by a fundamental principle of Lionel Robbins' definition of economics: scarcity. As such, it involves controlling the distribution of scarce resources

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and services among a population. Health care rationing is defined as denying a potentially beneficial treatment to a patient on the grounds of scarcity [1]. However, while Robbins argued that economics is a positive science, notably by excluding ethical considerations, it became evident for other authors that normative aspects are essential, particularly regarding healthcare [2].

Indeed, rationing certain public goods such as healthcare may raise ethical concerns. Rationing healthcare excludes people from the care they need, sometimes at the expense of their life, well-being, or quality of life. Then, even if rationing is necessary, it should be guided by ethical and social justice principles [3]. To whom should we give care, to whom should it be denied, and on which grounds? These are questions practitioners and managers should resolve when allocating scarce resources. There are many social justice theories. However, the literature often evokes three theories regarding healthcare rationing: utilitarianism, egalitarianism, and prioritarianism.

Modernized by cost–benefit or risk–benefit analyses, utilitarianism is a utility-based social theory born in the nineteenth century. It emphasizes the maximization of overall benefits at the societal level. In other words, according to this theory, fair resource allocation maximizes utility in society. However, utilitarianism has drawn some concerns about quantifying health benefits or distributing them equally: The greatest benefit for the greatest number of individuals implicitly means leaving some minorities behind. Therefore, utilitarianism does not necessarily address moral issues [4, 5].

John Rawls' theory of social justice has widely influenced egalitarian views with two main principles. The first is the importance of equality in rights and fundamental liberties among citizens. The second principle embodies two conditions: the fair equality of opportunity and the difference principle. The fair equality of opportunity highlights that morally acceptable inequalities must not be a source of injustice in access to certain social goods. The difference principle stipulates that if inequalities are allowed, they must benefit everyone, especially the least advantaged. Egalitarianism is built on the idea that every individual should be given an equal opportunity to access goods. Examples of rationing based on egalitarianism principles are queuing (first-come-first-served strategies), lotteries, or triage. In contrast to prioritarianism-based rationing, those egalitarian processes are “random” and require less information about individuals [3, 6].

Prioritarianism is the belief that scarce rationing resources should prioritize the worst off. Delimiting the scope of the definition of worst off is challenging. A worst-off person might be someone who experiences the

most significant loss of lifespan, often the youngest or the sickest. A central interrogation addressed in the literature and discussed further in our analysis is the role of non-health-related deprivation in determining who is worse off. The exceptionalism view holds that only health considerations should matter in the allocation of health resources, which is debatable. According to pluralistic beliefs, we should consider that all types of disadvantages, not just health-related disadvantages, are relevant when defining who is worst off [7, 8].

As kidney disease became one of the top 10 causes of death worldwide in 2019 [9], it is increasingly crucial to ensure access to renal replacement therapy, especially in low- and middle-income countries (LMIC). Due to the high cost of renal treatment, some of these countries have already implemented national maintenance dialysis programs. These programs cover expenses related to dialysis in public health facilities (in Thailand, Brazil, India, Algeria, Tunisia, Gabon, South Africa, and Senegal) [10]. Since 2012, Senegal has targeted End-Stage Renal Disease (ESRD) as a part of the national assistance program, which was a bold move given that non-communicable diseases are known to be cost drivers, regardless of the country's level of income.

At first, the national dialysis program partially subsidized dialysis costs. Then, in 2012, the state lifted all fees. National guidelines stipulate that every Senegalese diagnosed with ESRD is entitled to free dialysis sessions in the public sector. After diagnosis, the patient fills out a subscription form and sends a handwritten request letter to the hospital director. The Universal Health Coverage Agency recommends wait-listing ESRD patients due to the limited number of dialysis beds and the growing number of patients. The patient is then registered on the reserve list if there is no available dialysis bed. As every hospital manages a waiting list, a patient can register on multiple waiting lists. Meanwhile, patients who cannot access dialysis care in the public sector can seek assistance in the private sector only if they can afford it. On average, 1000 patients are regularly registered on waiting lists, and approximately 75% of ESRD patients die due to a lack of dialysis machines [11].

At the hospital level, committees decide whom to enroll after an assessment. Inclusion criteria to ration healthcare must meet certain ethical principles of health resource allocation encompassed in three categories: treating people equally, prioritizing the worst off, and maximizing total benefits [12]. Rationing strategies are not exclusive and can be used simultaneously. In South Africa, for example, dialysis rationing is expected, and the selection process responds to utilitarian principles [13, 14]. A retrospective study conducted at a center in Cape Town found that among eligible patients, the youngest

(aged between 20 and 40), the non-diabetic, the richest, and the white patients were more likely to receive dialysis than others. Some of those criteria are based on utilitarian considerations, such as comorbidities: non-diabetic patients have better outcomes from dialysis therapy than diabetic patients. Other criteria, such as age, are based on prioritarianism (younger patients have the most significant lifespan disadvantage if not treated) [15].

Although the benefits package is not comprehensive in Senegal, patients in public hospitals are entitled to three dialysis sessions a week in public hospitals. The free health care policy aims at improving financial access to dialysis in public hospitals. In addition to following the Universal Health Coverage Agency's recommendation to waitlist patients, committees set up at the hospital level proceed to a second recruitment process based on socioeconomic criteria that might not be homogeneous from one center to another. This study analyzes which social justice principles are applied to ration dialysis therapy at the hospital level. We conduct a multivariate logit regression analysis using data collected from patients in public and private centers to identify the determinants of enrollment. We hypothesize that if the egalitarian principle holds, the duration of the illness (or the duration of renal therapy) should be a dominant predictor of enrollment. Additionally, the effect of socioeconomic factors should not covary with the duration.

## Methods

As in many sub-Saharan countries, there is a lack of national data on ESRD in Senegal. However, a paper release recently provided some insights into the progression of the disease. The country has experienced an improvement in dialysis center implementation (2 functioning centers in 2000, 13 in 2017, and 17 in 2019) [11, 16]. Approximately 1092 patients had dialysis sessions in 2019, 590 patients had dialysis sessions in 2017 [16], and only 25 had dialysis sessions in 2014 [11, 16]. The average cost of one dialysis session was USD 108 in public centers before the exemption policy. It remains at approximately USD 117 in the private sector. In comparison, the adjusted net national income per capita was USD 1233 in 2018, according to the World Bank.

## Study design

We conducted the study in the urban area of Dakar. This is the most populated region in Senegal, and most of the country's ESRD patients and HD centers are located there. It is also the only region that provides renal replacement therapy in public and private centers, offering a costly alternative to patients who cannot access a dialysis bed in public hospitals. At the time that we requested authorization for the survey, four public

hospitals and four private centers provided dialysis sessions in Dakar. Our empirical strategy required data from the public and private sectors. We conducted a cross-sectional study between October 2018 and February 2019 in the eight dialysis centers. In public centers (centers A, B, and C), each patient was entitled to three dialysis sessions per week free of charge. Center D is an exception in two ways: First, it is under the Army's supervision, whereas other public hospitals are supervised by the Health Ministry. Second, due to the lack of human resources, patients in this center had only two dialysis sessions weekly instead of three.

In non-state-run centers, the number of dialysis sessions is highly related to income; it depends on patients' ability to pay:

- In center E, one dialysis therapy costs USD 117 (CFA francs 65,000).
- Center F has an agreement with the Ministry of Finance. As such, it receives civil servants and their dependents three times a week. The civil servants' contributory scheme covers dialysis costs.
- Center G is another private center that has signed an agreement with the Universal Health Coverage Agency that partially subsidizes dialysis costs for eligible patients.
- Center H is a private center set up by a patient organization. A dialysis session costs USD 18 (CFA francs 10,000).

We conducted interviews with patients in four municipalities of Dakar. The interviewed patients were over 18 years old and had been undergoing HD for at least one month. HD sessions might be scheduled differently according to the type of health facility. We attended day sessions for at least three days in each center, depending on the center size. We interviewed all patients who were able to respond until the end of all their sessions. We interviewed 201 patients, one of whom did not complete the interview because she was too sick. Five patients declined our request. Interviews lasted approximately 20–30 min and were conducted either in Wolof (the national language) or French.

## Descriptive statistics

The study's central question is whether national guidelines regarding patient enrollment in the free dialysis program are followed at the public hospital level. As a secondary objective, we analyze which social justice principles are applied in hospitals. We conduct a multivariate logit regression analysis using data collected from patients in public and private centers to identify the determinants of enrollment. The outcome variable is

whether the patient is dialyzed in a public hospital or a private center, and a YES answer means the patient benefits from the program. Control variables include chronicity and socioeconomic characteristics such as wealth status, insurance distribution, and education level. Chronicity is defined as a chronic or long-duration illness. In this study, we measure chronicity with the duration of hemodialysis. It is estimated in years and represents the period between the patient’s first dialysis session and the interview day. In our sample, 74% of patients have received dialysis for less than 5 years. Given the observed hemodialysis duration in public and private centers, we categorize the chronicity variable as follows: 1 if duration  $\leq 1$  year, 2 if  $1 \text{ year} < \text{duration} \leq 5$  years, and 3 if  $\text{duration} > 5$  years. The wealth index is measured using a principal component analysis based on assets owned by households. We also include sociodemographic characteristics such as age, transportation costs as a proxy for the distance to dialysis centers, and involvement in a patient organization represented by the variable “empowerment.” Patient organizations are platforms for empowerment, support, and information sharing and play a significant role in advocating for eliminating dialysis costs. Insurance distribution and education level are binary variables, while age is classified into three age groups. We normalize transportation costs.

Patients under dialysis for less than a year represent 44% of patients in the private sector and only 14% in the public sector (Table 1). However, we observe that when the dialysis duration is above five years, the proportion of dialysis patients enrolled in the program is more significant (47%). We observe a slight difference in the wealth index between the two subsamples. In addition, 79% of people enrolled in the program are not insured, compared to 54% in private centers. Only 21% of patients dialyzed in public centers have health insurance. ESRD strikes the

working-age population: 40- to 60-year-old patients represent half of the patients in state-run and non-state-run centers. Younger people are more present in public hospitals than in private hospitals. Educated patients are overrepresented in the sample. The results show that 64% of patients enrolled in the program have at least a primary-level education, compared to 79% in the private sector. More patients are involved in a patient organization in public dialysis centers than in private centers (43% vs. 19%). In comparison, 81% of patients treated in private centers do not belong to any patient association, compared to 57% among enrolled patients.

**Table 1** Percentage distribution of the sample by socioeconomic characteristics and type of center

Variables	Percentage (n)— mean $\pm$ SD		Chi-square test  P value
	Free health care		
	No (n)	Yes (n)	
Duration			
0–1 year	43.86 (50)	13.79 (12)	0.000
1–5 years	44.74 (51)	39.08 (34)	
+ 5 years	11.40 (13)	47.13 (41)	
Wealth Index			0.713
Poorest	20.18 (23)	20.69 (18)	
Poorer	21.93 (25)	17.24 (15)	
Middle	21.05 (24)	18.39 (16)	
Richer	16.67 (19)	24.14 (21)	
Richest	20.18 (23)	19.54 (17)	
Insurance distribution			0.000
Not insured	54.39 (62)	79.31 (69)	
Insured	45.61 (52)	20.69 (18)	
Age			0.054
18–40	19.30 (22)	32.56 (28)	
40–60	48.25 (55)	49.51 (40)	
+ 60	32.46 (37)	20.93 (18)	
Education			0.022
No formal education	21.05 (24)	35.63 (31)	
Education	78.95 (90)	64.37 (56)	
Empowerment			0.000
Not empowered	80.70 (92)	57.47 (50)	
Empowered	19.30 (22)	42.53 (37)	
Transportation costs (normalized)	0.13 $\pm$ 0.15	0.08 $\pm$ 0.09	–

**Results**

To identify the determinants of access to free dialysis care, we first conduct a multivariate analysis using an outcome binary model. This empirical strategy allows us to evaluate the likelihood of being dialyzed in public facilities depending on certain characteristics. Second, we check whether there are interaction effects between chronicity and other socioeconomic factors. We perform a marginal effects estimation to interpret the logit results. The multivariate logistic regression (Table 2) shows that chronicity is the main predictor of enrollment in the dialysis program. New entrant patients (under dialysis for less than a year) are 42% less likely to be dialyzed in the public sector than long-term patients (duration > 5 years), and patients under dialysis for one to five years are 27% less likely to be enrolled. This is consistent with the statistical analysis since the average duration of illness is twice as high in the public sector than in the private sector (Table 4). Patients in the 4th

**Table 2** Multivariate logistic analysis predicting the likelihood of benefiting from the FHC policy

Variables	Coef
Chronicity	
< 1 year	− 2.188 *** (0.563)
1–5 years	− 1.377*** (0.413)
+ 5 years	–
Wealth quintile	
Poorest	–
Poorer	− 0.330 (0.469)
Middle	0.092 (0.509)
Richer	1.010* (0.506)
Richest	0.410 (0.571)
Insurance	
Non-insured	–
Insured	− 1.109*** (0.424)
Age	
18–40	–
40–60	− 0.666* (0.422)
+ 60	− 1.138** (0.541)
Education	
Non-educated	–
Educated	− 0.863*** (0.390)
Patient organization	
No	–
Yes	0.794** (0.392)
Transportation costs	− 2.532 (2.068)
Constant	3.466*** (0.732)
Observations	200

dy/dx for factor levels is the discrete change from the base level

\*\*\* $p \leq 0.01$ , \*\* $p \leq 0.05$ , \* $p \leq 0.1$

wealth quintile have a higher probability of enrolling in the program than those in the poorest quintile (+ 17%). The silver lining for equity is that patients with insurance are less likely to be dialyzed in the public sector, with a 19% lower chance of entering the program.

The free health care policy is unfavorable to the most educated patients (− 15%). The hospital committee also considers patients’ age in some cases and tends to favor the youngest. Our results confirm this situation, as we observe that patients are less likely to be enrolled as they grow older. Compared to those under 40, patients aged between 40 and 60 have a 12% lower chance of registering, and elderly patients have a 20% lower chance of being enrolled. Empowerment increases the probability of entering the program. Patients involved in a patient organization are 15% more likely to benefit from free dialysis care. Transportation costs, a proxy for the distance to a hospital or a dialysis center, are not significant.

**Table 3** Average marginal effects (AME)

Variables	AME	SE
< 1 year		
Poorest	− 0.409***	(0.098)
Poorer	− 0.389***	(0.096)
Middle	− 0.413***	(0.095)
Richer	− 0.404***	(0.097)
Richest	− 0.420***	(0.095)
Uninsured	− 0.449***	(0.100)
Insured	− 0.394***	(0.094)
18–40	− 0.424***	(0.097)
40–60	− 0.431***	(0.097)
Over 60	− 0.405***	(0.097)
No education	− 0.421***	(0.098)
Educated	− 0.421***	(0.095)
Unempowered	− 0.418***	(0.094)
Empowered	− 0.423***	(0.097)
1–5 years		
Poorest	− 0.273***	(0.083)
Poorer	− 0.268***	(0.084)
Middle	− 0.273***	(0.082)
Richer	− 0.241***	(0.073)
Richest	− 0.268***	(0.080)
Uninsured	− 0.281 ***	(0.080)
Insured	− 0.281***	(0.089)
18–40	− 0.257***	(0.075)
40–60	− 0.282***	(0.084)
Over 60	− 0.279***	(0.086)
No education	− 0.254***	(0.075)
Education	− 0.282***	(0.084)
Unempowered	− 0.280***	(0.083)
Empowered	− 0.258***	(0.077)
> 5 years	Baseline	

dy/dx for factor levels is the discrete change from the base level

\*\*\* $p \leq 0.01$

Overall, the results show that chronicity, education, age, the wealth index, and involvement in a patient organization play essential roles in enrollment. To determine whether illness duration is the only factor determining enrollment, we measure the average marginal effects of socioeconomic variables for each duration level. In other words, for each category of control variables, we assess the predicted probabilities of being in the program depending on illness duration.

Table 3 shows the predicted probabilities of being dialyzed in state-run centers. The poorest new entrants are 41% less likely to have dialysis in the public sector than the poorest long-term patients. Nevertheless, we are now interested in whether this percentage varies

significantly across wealth index levels. The wealthiest new entrants are more disadvantaged than the others. However, variations are slight and range from 1% to 3%, so we consider that the duration effect does not covary considerably within wealth index quintiles. The same conclusion holds for the remaining variables. Uninsured and 40- to 60-year-old new entrants have a lower probability of entering the program than insured and younger new entrants. However, the duration effect is similar across levels of variables for education and empowerment (−42%), and it covaries slightly between age groups (1%–3%). The duration effect is stronger among uninsured patients than among insured patients (+6% between uninsured and insured patients).

Similarly, the duration effect covaries slightly for patients under dialysis for 1–5 years. Their probabilities are identical across wealth quintiles (around −27%) except for patients in the fourth quintile (−24%). Younger patients have a higher likelihood of enrollment (+2%) than older patients; patients without education are more likely to benefit from free health care (+3%) than educated patients, and finally, empowered patients are more likely to be enrolled than unempowered patients (+2%).

## Discussion

End-stage kidney disease is so costly that even if people initially gain access to treatment, it might bankrupt them over time. Even worst, 75% of patients aware of their diagnosis may not receive any dialysis sessions and may die, even though the state has made enormous efforts in implementing dialysis centers in every region. The state finances the national dialysis program. Specific funding managed separately by the Universal Health Coverage Agency is dedicated to replacing the forgone income from user charges. Public resources are not enough to absorb all the demand, and not every patient can benefit from public services. Thus, the agency uses explicit rationing through a first-come-first-served strategy (egalitarianism approach). Interviews with doctors and nurses revealed that in addition to using waiting lists, hospitals select patients according to their age and their socioeconomic status (prioritarianism approach). We analyze here two ethical values that underline those decisions.

### Egalitarian rationing: Are people treated equally?

In health policy, egalitarianism implies “that each member of society, irrespective of wealth or position, has equal access to an adequate, although not maximal, level of health care—the exact level of access being contingent on available social resources and public processes of decision making” [5]. Lottery and queuing are considered egalitarian methods of resource allocation. The first-come-first-served strategy is a variation of queuing, but

is it egalitarian? Based on our model and determinants, hemodialysis duration might be an indicator. If the process is egalitarian, two conditions should be met: First, duration is the strongest predictor of the model, and the longer the duration of hemodialysis, the higher the probability of enrollment in the program. The second condition is that patients with an equal hemodialysis duration must have an equal chance to access the program, regardless of other determinants (socioeconomic factors, education level, insurance distribution, etc.). Our results fulfill those two conditions. The rationing process follows Rawls’ second ethical rule: Differences in wealth or education, for example, do not favor an unequal opportunity to access renal replacement therapy.

However, under scrutiny, the whole process might not be as egalitarian as we think. Who is registered on waiting lists? And most importantly, who is not? ESRD is a silent condition; it can take years before being diagnosed. Consequently, people who can access health services frequently are more likely to get on waiting lists first. Considering that a lack of dialysis is a death sentence, waiting lists comprise patients who can access dialysis sessions in private centers. People who finally make it into the program are those who have survived long enough, that is, those who could afford dialysis sessions in the private sector while waiting to be enrolled in the program. The high mortality rate among people registered on waiting lists may indicate that impoverished patients probably die before reaching a dialysis bed because of the high cost of dialysis in the private sector.

Social capital and access to information may also play a key role in access to public centers. The example of center D is illustrative. This center had just started functioning when we began the survey there in December 2018. At the time, barely a dozen patients received dialysis in that center twice a week. We notice in Table 4 a considerable difference between center D and the other public centers in terms of chronicity (mean duration 0.85 versus 5.29 for public centers in general). This center operates as a non-state-run center, and it shares similar characteristics with center E. Let us assume that every patient respected the queue. This would mean that patients still alive and registered on a waiting list were now private-sector regulars and were no longer interested in a public dialysis bed. Alternatively, they did not register on the waiting list because they were not aware of the new center opening. The first hypothesis is plausible, particularly among insured patients dialyzed in the private sector, but very unlikely among those without insurance and under dialysis for years.

Transparency and information sharing are crucial in applying an egalitarian approach to rationing. However, opening waiting lists in each center might facilitate

**Table 4** Observed duration of hemodialysis in public and private centers (in years). *Source:* Authors' calculation from their survey data

Type	Centers	Mean duration	Min	Max
Public		<b>5.29*</b>		
(28)	A	5.2	0.50	9
(11)	B	4.76	0.83	15
(41)	C	6.24	0.42	14
(07)	D	0.85	0.17	2
Private		<b>2.39*</b>		
(18)	E	0.94	0.02	3
(39)	F	2.89	0.08	11
(39)	G	2.5	0.08	20
(18)	H	2.5	0.50	7

Bold represents the average mean duration in all public centers (5.29) and private centers (2.39)

() Number of patients interviewed in the center

\*Average mean duration in public and private centers

corruption, give doctors or managers discretionary power, or reduce the opportunity for patients to receive good information on time. Without total transparency, a well-off and newly diagnosed patient can be given an unfair advantage to the considerable detriment of the least privileged patients who did not have information regarding the new center opening and did not request a spot. That situation would make the process unfair and unethical.

**Priority view of rationing: Are the worst off prioritized?**

Prioritarianism favors the worst off in resource allocation, for example, by using the age factor. To answer whether the worst off are prioritized, we first need to decide whom we consider the worst off. Here, we adopt the pluralistic view of prioritarianism: Dialysis allocation should consider any deprivation, including health-related and economic deprivations. Some circumstances can justify the fairness of rationing by age. This practice is frequent in dialysis and organ transplantation, notably since studies have shown that younger people are more receptive and that therapy is more likely to work with them than with elderly patients. An organ may be allocated to a young man to the detriment of an older man because the former will live longer with the new organ. From utilitarianism and prioritarianism perspectives, the choice might be fair [5]. Prioritarianism is also about allowing everyone to have a normal lifespan when allocating scarce health resources. Our results suggest that the older patients are, the smaller their chance of entering the program. However, this finding is not sufficient to confirm that younger patients have priority over elderly

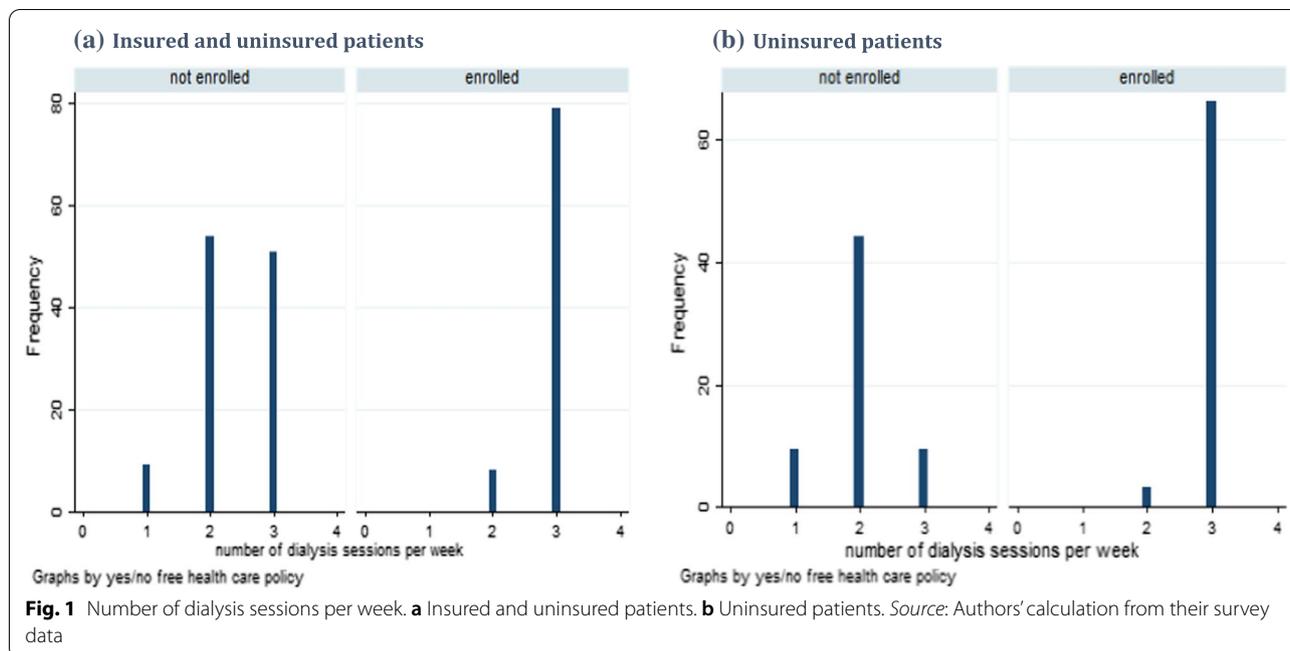
**Table 5** Percentage of Dakar urban population and HD users. *Source:* Authors' calculation from their survey data

Urban quintiles	Percent of Dakar population	Percent of HD users	Public	Private
Poorest 20%	6.77	0.5	1.15	0
2nd quintile	16	3	1.15	4.42
3rd quintile	23.38	9.5	11.49	7.96
4th quintile	27.08	31	24.14	36.28
Richest 20%	26.77	56	62.07	51.33

patients with equal illness duration. The average marginal effects are almost the same across age categories; new entrants are 42% to 45% less likely to enter the program than long-term patients, depending on their age class. In addition, patients over 60 have better odds (− 42%) than patients ages 40–60 (− 45%). However, among patients under dialysis for one to five years, younger patients have a slight advantage (+ 3%).

Although a social worker is present in committees to advocate for poorer patients, our results do not show significant differences between wealth quintiles regarding access to free dialysis therapy, even when considering increases in illness duration. The poorest new entrants and the richest new entrants have the same probabilities of being enrolled. However, we are comparing patients who already have access to renal therapy. To investigate this matter further, we calculate the wealth index based on Thiede et al.'s methodology [17], also recommended by the World Bank for a specific and limited survey such as ours [18]. Instead of comparing patients to each other as we did in our empirical analysis, this methodology allows us to classify patients against the wealth index distribution in the urban area of Dakar. Using the assets and housing conditions recorded in the 2015 Demographic and Health Survey (DHS), we compute weights from the 2015 national survey. We apply them to our survey, which allows us to calculate the index scores relative to the Dakar urban population. These indices are assessed against the 2015 national distribution of the wealth index. Our reference population (Dakar metropolitan area) extracted from the 2015 DHS is composed of 325 households. The lowest wealth quintiles represent barely 23% of the reference population and few HD users (3.5%). The upper two wealth quintiles represent approximately 54% of the reference population and 87% of HD users. Wealthier patients are overrepresented in the program (86%), while poor patients are nearly absent in private or public sector care (Table 5).

The wealth index distribution has two implications: Either the richest are more threatened by ESRD than the



poorest, or the poorest fail to access dialysis therapy due to financial considerations. Two studies conducted in Côte d'Ivoire [19] and Madagascar [20] found that lower economic status was more represented among patients. When we look at the risk factors for ESRD, the evidence is mixed. Some authors found that diabetes prevalence, for example, was positively correlated with high income in developing countries [21–23], while hypertension was associated with low socioeconomic status or education level [24, 25]. Consequently, given that diabetes and hypertension are the leading causes of CKD in Senegal [26], we cannot conclude that it predominantly affects rich people. Our second hypothesis, that impoverished people do not have access to dialysis therapy, is plausible given the high mortality rate among people waiting for a dialysis bed in public hospitals.

#### Demand-side rationing

The longer people seek assistance in private centers, the higher their risk of financial hardship. Private centers also have ways to ration care based on patients' ability to pay, and patients ration dialysis therapy by having fewer sessions than they should. Figure 1a, b shows the distribution of dialysis sessions per type of center (public or private). Most patients have three sessions a week in the public sector. In the private sector, however, especially among uninsured patients, 87% of patients undergo less than three dialysis sessions per week. This situation should alert public health authorities to strengthen the

dialysis supply by increasing the number of dialysis units, increasing the health workforce, and most importantly, promoting preventive actions against ESRD, particularly among individuals with high blood pressure or diabetes. At first glance, multiplying dialysis care centers is fundamental, but the core challenge is the health workforce's availability. For this reason, as mentioned earlier, center D could provide only two sessions per week in 2018 (instead of 3) for 11 patients, when it could have been receiving eleven more patients three times a week.

#### Conclusion

In Senegal, where organ donation and transplantation are not yet available, dialysis is the only renal replacement therapy for end-stage kidney disease patients. However, dialysis is a costly treatment; a session costs USD 110 on average. Three sessions a week are necessary to maintain a good quality of life, and a lack of treatment is eventually a death sentence. In 2012, under the pressure of dialysis associations, the government lifted user fees in public hospitals. It launched the free dialysis care program as part of a broader plan to achieve universal health coverage. Private–public partnerships enable some patients who cannot be dialyzed in the public sector to receive treatment at a subsidized cost in private centers, depending on dialysis machines availability. The remaining patients must pay the total price in the private sector. The Senegalese government sought to ensure renal therapy access to every citizen who needs it by lifting dialysis fees

in public hospitals. Nevertheless, it ended up rationing dialysis due to the growing number of patients.

Although queuing has been described as an egalitarian rationing mechanism, it is not corruption-free. Therefore, transparency issues can threaten it, notably when well-off people use their power or social capital to decrease their waiting times. Overall, the results do not reflect a double standard of enrollment for patients already present in healthcare facilities. Our results are consistent with national recommendations and confirm the initial hypothesis of the first-come-first-served rationing principle.

Thailand is an excellent example of an LMIC that has attained universal renal replacement therapy coverage (dialysis and transplantation). The Thai government introduced dialysis in the benefits package for civil servants and social security schemes in 1980 and 1990, respectively, and in the Universal Health Coverage Scheme (UHCS) in 2005 after a cost assessment. Societal dialogue immediately before dialysis was introduced in the UHCS suggested that authorities would prioritize vulnerable people if rationing was needed. To ensure that dialysis access was universal, the Thai government decreed one condition: Patients would not get to choose between peritoneal dialysis and hemodialysis. Therapy would be provided for free only if the patient agreed to receive peritoneal dialysis, which is considered less expensive and more accessible than HD. That was the trade-off to ensure that every citizen in need of dialysis was satisfied. This policy success has a lot to do with patient empowerment and the increase in the health workforce and dialysis units, which limited rationing [27].

Senegal has not yet achieved universal access to dialysis. The absence of the most impoverished people in our sample signals that they struggle to access dialysis therapy, which means that this policy raises essential equity issues. The process is more selective than it appears since remaining on waiting lists comes at a price. Health authorities need to make consistent efforts to ease access to dialysis care for the most vulnerable people and prioritize them if rationing is necessary. As a short-term solution, the state could subsidize more beds and treatment in the private sector by strengthening public-private partnerships. The waiting list should be centralized and steered by the Universal Health Coverage Agency. The agency would then be responsible for patients' enrollment in the free dialysis program based on objective and transparent criteria and under the control of patient organizations. Eventually, the government must implement more dialysis centers and reinforce the workforce. In the long run, the promotion and development of non-communicable disease prevention and screening, notably

diabetes and hypertension, are crucial at primary care levels. For now, the free health care policy may offer the same opportunity to patients who already benefit from renal therapy, but outside public centers, inequalities remain.

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#### Author contributions

FMF contributed to conceptualization, methodology, software data curation, writing—original draft preparation, visualization, investigation, and writing and provided software. MA was involved in supervision, validation, conceptualization, reviewing, and editing. All authors read and approved the final manuscript.

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#### Availability of data and materials

The data that support the findings of this study are available from the corresponding author, FMF, upon reasonable request.

#### Declarations

##### Ethics approval and consent to participate

The National Committee (Ministry of Health and Social Affairs) approved the study (reference No. 000105/MSAS/DPRS/CNERS). The respondents were assured about the confidentiality of information given, and informed consent was obtained for the survey.

##### Consent for publication

Not applicable.

##### Competing interests

The authors declare no competing interests.

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